SPECIFICATIONS AND CONTRACT DOCUMENTS
FOR
BEAR RIVER WATER CONSERVANCY DISTRICT

HARPER WARD WELL EQUIPPING

JANUARY 2025

BID - SET

Project No. 57-22-023

1047 South 100 West, Ste. 180, Logan, UT 84321
p **435 713 9514** *f* **435 713 9503** *w* **www.jub.com**

OTHER J-U-B COMPANIES THE LANGDON GROUP GATEWAY MAPPING INC.

NOTICE AND DISCLAIMER

THE PLANS AND/OR SPECIFICATIONS (DOCUMENTS) ARE THE PROPERTY OF J-U-B ENGINEERS, INC. ("J-U-B") AND BY USING THE DOCUMENTS YOU AGREE TO BE BOUND BY THE TERMS AND CONDITIONS IN THIS NOTICE AND DISCLAIMER.

THE USE OF THE DOCUMENTS CREATES NO DUTY IN CONTRACT, TORT, EQUITY OR OTHERWISE OF J-U-B TO THE USER. THE USER SHALL NOT (I) DISSEMINATE THE DOCUMENTS, OR ANY PART THEREOF, TO OTHERS WITHOUT THE WRITTEN CONSENT OF J-U-B, OR (II) USE THE DOCUMENTS, OR ANY PART THEREOF, FOR ANY USE OTHER THAN AS DESIGNATED HEREIN FOR THE INTENDED PROJECT. THE DOCUMENTS ARE NOT INTENDED FOR USE IN CREATING DTM FOR GRADING OR EARTHWORK, SURVEY STAKING LAYOUT (UNLESS SPECIFICALLY IDENTIFIED AS SUCH IN THE DOCUMENTS), OR PROPERTY BOUNDARY LAYOUTS.

J-U-B AND ITS AGENTS SHALL NOT BE LIABLE FOR ANY DAMAGES OR CLAIMS ARISING OUT OF THE UNAUTHORIZED USE OR MISUSE OF THE DOCUMENTS, OR ANY PART THEREOF, WHETHER SUCH DAMAGE OR CLAIM IS BASED IN CONTRACT, TORT OR OTHERWISE. THE USER HEREBY RELEASES AND SHALL DEFEND, INDEMNIFY AND HOLD J-U-B AND ITS AGENTS HARMLESS FROM ANY DAMAGES OR CLAIMS ARISING OUT OF, OR RELATED IN ANY WAY TO, THE USER'S UNAUTHORIZED USE OR MISUSE OF THE DOCUMENTS, OR ANY PART THEREOF.

IF THE DOCUMENTS ARE PROVIDED IN ELECTRONIC FORMAT, THE ELECTRONIC DOCUMENTS ARE SUBJECT TO THE PROVISIONS OF J-U-B's "ELECTRONIC DOCUMENT/DATA LIMITED LICENSE" FOUND AT edocs.jub.com

THIS PAGE INTENTIONALLY LEFT BLANK

BEAR RIVER WATER CONSERVANCY DISTRICT
HARPER WARD WELL EQUIPPING PROJECT

TABLE OF CONTENTS

Contract Documents

Technical Specifications

Plans

THIS PAGE INTENTIONALLY LEFT BLANK

ADVERTISEMENT FOR BIDS

BEAR RIVER WATER CONSERVANCY DISTRICT
BRIGHAM CITY, UTAH

General Notice

Bear River Water Conservancy District (Owner) is requesting Bids for the construction of the following Project: **Harper Ward Well Equipping**

Bids for the construction of the Project will be received at the BRWCD Offices located at **102 W Forest St, Brigham City, UT 84302**, until **Wednesday, March 5th at 1:00pm** local time. At that time the Bids received will be publicly opened and read.

The project consists of installing a CMU well house, interior well piping and equipment, well pump and motor in an existing well casing, HVAC system, electrical system, standby generator, buried piping, concrete work, site grading, and connection to existing piping.

The Project has a substantial completion date of **November 21, 2025** and final completion date of **December 12, 2025**.

Funding Requirements

This agreement is for services related to a project that is subject to the Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act ("IIJA"), Pub. L. 177-58. Absent an approved waiver, all iron, steel, manufactured products, and construction materials used in this project must be produced in the United States, as further outlined by the Office of Management and Budget's Memorandum M-22-11, Initial Implementation Guidance on Application of Buy America Preference in Federal Financial Assistance Programs for Infrastructure, April 18, 2022.

Obtaining the Bidding Documents

Information and Bidding Documents for the Project can be found at the following designated website:
www.jub.com – Select "Plans" tab at top of page, Quest Number #9521588

The designated website will be updated periodically with addenda, lists of registered plan holders, reports, and other information relevant to submitting a Bid for the Project. All official notifications, addenda, and other Bidding Documents will be offered only through the designated website. Neither Owner nor Engineer will be responsible for Bidding Documents, including addenda, if any, obtained from sources other than the designated website.

Pre-bid Conference

A pre-bid conference for the Project will be held on **Wednesday, February 12, 2025 at 1:00pm** at the BRWCD Offices located at **102 W Forest St, Brigham City, UT 84302**. Attendance at the pre-bid conference is encouraged but not required. A site visit will be conducted following the pre-bid conference.

This Advertisement is issued by:

Owner: Bear River Water Conservancy District
By: Chance Baxter
Title: General Manager
Date: 1/31/2025

EJCDC® C-111, Advertisement for Bids for Construction Contract.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACT

TABLE OF CONTENTS

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 1—DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

A. *Issuing Office*—The office from which the Bidding Documents are to be issued, and which registers plan holders.

ARTICLE 2—BIDDING DOCUMENTS

2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.

2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.

2.03 Owner has established a Bidding Documents Website as indicated in the Advertisement or invitation to bid. Owner recommends that Bidder register as a plan holder with the Issuing Office at such website and obtain a complete set of the Bidding Documents from such website. Bidders may rely that sets of Bidding Documents obtained from the Bidding Documents Website are complete, unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.

2.04 *Deleted*

2.05 Plan rooms (including construction information subscription services, and electronic and virtual plan rooms) may distribute the Bidding Documents or make them available for examination. Those prospective bidders that obtain an electronic (digital) copy of the Bidding Documents from a plan room are encouraged to register as plan holders from the Bidding Documents Website or Issuing Office. Owner is not responsible for omissions in Bidding Documents or other documents obtained from plan rooms, or for a Bidder's failure to obtain Addenda from a plan room.

2.06 *Electronic Documents*

A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.

1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader. It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.

B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.06.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

3.01 *Deleted*

3.02 *Deleted*

3.03 To demonstrate Bidder's qualifications to perform the Work, after submitting its Bid and within **5** days of Owner's request, Bidder must submit the following information:

A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.

B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.

C. Bidder's state or other contractor license number, if applicable.

D. Subcontractor and Supplier qualification information.

3.04 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.

3.05 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

ARTICLE 4—PRE-BID CONFERENCE

4.01 *Deleted*

4.02 A non-mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are highly encouraged to attend and participate in the conference; however, attendance at this conference is not required to submit a Bid.

4.03 *Deleted*

4.04 Information presented at the pre-Bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

at the pre-Bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

ARTICLE 5—SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

5.01 *Site and Other Areas*

A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

5.02 *Existing Site Conditions*

A. *Subsurface and Physical Conditions; Hazardous Environmental Conditions*

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:

a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.

b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.

c. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.

d. Technical Data contained in such reports and drawings.

2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

4. Deleted

B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05 of the General Conditions, and not in the drawings referred to in Paragraph 5.02.A of these Instructions to Bidders. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

5.03 *Other Site-related Documents*

A. In addition to the documents regarding existing Site conditions referred to in Paragraph 5.02.A, the following other documents relating to conditions at or adjacent to the Site are known to Owner and made available to Bidders for reference:

1. **None**

Owner will make copies of these other Site-related documents available to any Bidder on request.

B. Owner has not verified the contents of these other Site-related documents, and Bidder may not rely on the accuracy of any data or information in such documents. Bidder is responsible for any interpretation or conclusion Bidder draws from the other Site-related documents.

C. The other Site-related documents are not part of the Contract Documents.

D. Bidders are encouraged to review the other Site-related documents, but Bidders will not be held accountable for any data or information in such documents. The requirement to review and take responsibility for documentary Site information is limited to information in (1) the Contract Documents and (2) the Technical Data.

E. No other Site-related documents are available.

5.04 *Site Visit and Testing by Bidders*

A. Bidder is required to visit the Site and conduct a thorough visual examination of the Site and adjacent areas. During the visit the Bidder must not disturb any ongoing operations at the Site.

B. A Site visit is scheduled following the pre-bid conference.

C. Deleted

D. Bidders visiting the Site are required to arrange their own transportation to the Site.

E. Deleted

F. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.

G. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.

H. Bidder must comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.

I. Bidder must fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

5.05 *Owner's Safety Program*

A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be noted in the Supplementary Conditions.

5.06 *Other Work at the Site*

A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Express Representations and Certifications in Bid Form, Agreement*

A. The Bid Form that each Bidder will submit contains express representations regarding the Bidder's examination of Project documentation, Site visit, and preparation of the Bid, and certifications regarding lack of collusion or fraud in connection with the Bid. Bidder should review these representations and certifications and assure that Bidder can make the representations and certifications in good faith, before executing and submitting its Bid.

B. If Bidder is awarded the Contract, Bidder (as Contractor) will make similar express representations and certifications when it executes the Agreement.

6.02 *Bidder is familiar with all laws and regulations that may affect cost, progress, and performance of the work, including BABAA requirements.*

ARTICLE 7—INTERPRETATIONS AND ADDENDA

7.01 Owner on its own initiative may issue Addenda to clarify, correct, supplement, or change the Bidding Documents.

7.02 Bidder shall submit all questions about the meaning or intent of the Bidding Documents to Engineer in writing. Contact information and submittal procedures for such questions are as follows:

A. **Submit questions via procurement website listed in the advertisement.**

7.03 Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all registered plan holders. Questions received less than seven days prior to the date for opening of Bids may not be answered.

7.04 Only responses set forth in an Addendum will be binding. Oral and other interpretations or clarifications will be without legal effect. Responses to questions are not part of the Contract Documents unless set forth in an Addendum that expressly modifies or supplements the Contract Documents.

ARTICLE 8—BID SECURITY

8.01 A Bid must be accompanied by Bid security made payable to Owner in an amount of **5** percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

form of a Bid bond issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions.

8.02 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract and furnish the required Contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited, in whole in the case of a penal sum bid bond, and to the extent of Owner's damages in the case of a damages-form bond. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.

8.03 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of 7 days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.

8.04 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

ARTICLE 9—CONTRACT TIMES

9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.

9.02 *Deleted*

9.03 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 10—SUBSTITUTE AND "OR EQUAL" ITEMS

10.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or "or-equal" items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or "or-equal" item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.

*A. Any request for substitute or "or equal" shall include the Manufacturer's Certification of compliance with the Build America, Buy America Act (**BABAA**) requirements mandated by Title IX of the Infrastructure Investment and Jobs Act ("IIJA"), Pub. L. 177-58.*

10.02 *Deleted*

10.03 All prices that Bidder sets forth in its Bid will be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of "or-equal" or substitution requests are made at Bidder's sole risk.

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so by the Bidding Documents or in the Specifications. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.

11.02 The apparent Successful Bidder, and any other Bidder so requested, must submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work within **5** days after Bid opening:

A. **All aspects of work to be performed by Subcontractor(s).**

11.03 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

11.04 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

ARTICLE 12—PREPARATION OF BID

12.01 The Bid Form is included with the Bidding Documents.

A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.

B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."

12.02 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents. The printed copy of the Bid Form must be clearly legible, printed on 8½ inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.

12.03 A Bid by a corporation must be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown.

12.04 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.

12.05 A Bid by a limited liability company must be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.

12.06 A Bid by an individual must show the Bidder's name and official address.

12.07 A Bid by a joint venture must be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.

12.08 All names must be printed in ink below the signatures.

12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.

12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.

12.11 The Bid must contain evidence of Bidder's authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.

12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

ARTICLE 13—BASIS OF BID

13.01 *Deleted*

13.02 *Deleted*

13.03 *Deleted*

13.04 *Deleted*

13.05 *Unit Price*

A. Bidders must submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.

B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity", which Owner or its representative has set forth in the Bid Form, for the item and the corresponding "Bid Unit Price" offered by the

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.

C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

13.06 *Allowances*

A. For cash allowances the Bid price must include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

13.07 *Deleted*

ARTICLE 14—SUBMITTAL OF BID

14.01 The Bidding Documents include one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 2 of the Bid Form.

14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid and must be enclosed in a plainly marked package with the Project title, and, if applicable, the designated portion of the Project for which the Bid is submitted, the name and address of Bidder, and must be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid must be addressed to the location designated in the Advertisement.

14.03 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

15.01 An unopened Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.

15.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 15.01 and submit a new Bid prior to the date and time for the opening of Bids.

15.03 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 its Bid, the Bidder may withdraw its Bid,

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

ARTICLE 16—OPENING OF BIDS

16.01 Bids will be opened at the time and place indicated in the advertisement or invitation to bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

16.02 *Deleted*

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

17.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

18.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.

18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.

18.03 If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.

18.04 If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.

18.05 *Evaluation of Bids*

A. In evaluating Bids, Owner will consider whether the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.

B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form. To determine the Bid prices for purposes of comparison, Owner will announce to all bidders a "Base Bid plus alternates" budget after receiving all Bids, but prior to opening them. For comparison purposes alternates will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded. After determination of the Successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these Instructions, the award may be made to said Successful Bidder on its base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award.

C. For the determination of the apparent low Bidder when unit price bids are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

18.06 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

18.07 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 19—BONDS AND INSURANCE

19.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds, other required bonds (if any), and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.

19.02 Article 8, Bid Security, of these Instructions, addresses any requirements for providing bid bonds as part of the bidding process.

ARTICLE 20—SIGNING OF AGREEMENT

20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner. Within 10 days thereafter, Owner will deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 21—SALES AND USE TAXES

ARTICLE 22—CONTRACTS TO BE ASSIGNED

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

BID FORM FOR CONSTRUCTION CONTRACT

The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 1—OWNER AND BIDDER

1.01 This Bid is submitted to: Bear River Water Conservancy District, 102 W Forest St, Brigham City, UT 84302.

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2—ATTACHMENTS TO THIS BID

2.01 The following documents are submitted with and made a condition of this Bid:

A. Required Bid security;

B. *Deleted*

C. *Deleted*

D. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such authority within the time for acceptance of Bids;

E. Contractor's license number as evidence of Bidder's State Contractor's License or a covenant by Bidder to obtain said license within the time for acceptance of Bids

2.02 The following documents are to be submitted within **5** days of Bid Opening, apparent low Bidder must submit the following information:

A. List of Proposed Subcontractors;

B. List of Proposed Suppliers;

ARTICLE 3—BASIS OF BID—LUMP SUM BID AND UNIT PRICES

3.01 *Deleted*

3.02 *Unit Price Bids*

A. Bidder will perform the following Work at the indicated unit prices:

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Item #	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
General					
1	Mobilization	LS	1		
2	Startup and Commissioning	LS	1		
Site Civil					
3	Untreated Base Course (Type A4)	CY	200		
4	12” DI Waterline	LF	40		
5	8” PVC & DI Pump to Waste Line	LF	75		
6	4” PVC Building Drain Line	LF	100		
7	Concrete Sidewalk and Generator Pad	SF	606		
8	Well House Retaining Wall	LF	23		
9	Final Site Grading and Restoration	LS	1		
Well Building					
10	Building Concrete & Reinforcing	LS	1		
11	Structural Masonry & Reinforcing	LS	1		
12	Building Metal Fabrications	LS	1		
13	Rough Carpentry	LS	1		
14	Prefabricated Truss Package	LS	1		
15	Thermal and Moisture Protection	LS	1		
16	Rigid Insulation	LS	1		
17	Batt/Blown-in Insulation	LS	1		
18	Roofing	LS	1		
19	Building Roof Access Hatches	EA	1		
20	Windows, Frames, & Hardware	LS	1		
21	Doors, Frames, & Hardware	LS	1		

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Item #	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
22	FRP Paneling	LS	1		
23	Plumbing	LS	1		
24	HVAC	LS	1		
25	Well House Process Mechanical Piping	LS	1		
26	Well Pump and Motor	LS	1		
27	Well Pre-Lube System	LS	1		
28	Chlorination System	LS	1		
29	Standby Generator	LS	1		
30	Electrical Power Service	LS	1		
31	Building Electrical	LS	1		
32	SCADA (SKM Subcontractor)	LS	1		
Total of All Unit Price Base Bid Items					**$**

* Bid Item is subcontracted work that Bidder will coordinate with.

B. Bidder acknowledges that:

1. Each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and

2. Estimated quantities are not guaranteed and are solely for the purpose of comparison of Bids, and final payment for all Unit Price Work will be based on actual quantities, determined as provided in the Contract Documents.

ARTICLE 4—TIME OF COMPLETION

4.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

4.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 5—BIDDER'S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA

5.01 *Bid Acceptance Period*

A. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

5.02 *Instructions to Bidders*

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

5.03 *Receipt of Addenda*

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Bidder's Representations*

A. In submitting this Bid, Bidder represents the following:

1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work, *including BABAA Requirements*.
4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

8. Bidder 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 Bidding Documents.

9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 *Bidder's Certifications*

A. The Bidder certifies the following:

1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.

2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.

3. Bidder has not solicited or induced any individual or entity to refrain from bidding.

4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:

a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.

b. Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.

c. Collusive practice means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.

d. Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

BIDDER hereby submits this Bid as set forth above:

Bidder:

_____

(typed or printed name of organization)

By: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.

Attest: _____

(individual's signature)

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Date: _____

(typed or printed)

Address for giving notices:

_____

_____

Bidder's Contact:

Name: _____

(typed or printed)

Title: _____

(typed or printed)

Phone: _____

Email: _____

Address:

_____

_____

_____

Bidder's Contractor License No.: (if applicable) _____

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

BID BOND (PENAL SUM FORM)

Bidder	**Surety**
Name:	Name:
Address *(principal place of business)*:	Address *(principal place of business)*:
Owner	**Bid**
Name: Bear River Water Conservancy District	Project *(name and location)*:
Address *(principal place of business)*:	**Harper Ward Well Equipping Project**
102 W Forest St Brigham City, UT 84302	Bid Due Date:
Bond	
Penal Sum:	
Date of Bond:	

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

Bidder	Surety
_____	_____
(Full formal name of Bidder)	*(Full formal name of Surety) (corporate seal)*
By: _____	By: _____
(Signature)	*(Signature) (Attach Power of Attorney)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____
Attest: _____	Attest: _____
(Signature)	*(Signature)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title:	Title:

Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation will be null and void if:
    3.1. Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
    3.2. All Bids are rejected by Owner, or
    3.3. Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond will be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

NOTICE OF AWARD

Date of Issuance:			
Owner:	Bear River Water Conservancy District	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	57-22-023
Project:	Harper Ward Well Equipping		
Contract Name:	Harper Ward Well Equipping		
Bidder:			
Bidder's Address:			

You are notified that Owner has accepted your Bid dated _____ for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

> Installing a CMU well house, interior well piping and equipment, well pump and motor in an existing well casing, HVAC system, electrical system, standby generator, buried piping, concrete work, site grading, and connection to existing piping.

The Contract Price of the awarded Contract is $_____ Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

An unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner **1** counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

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

Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: Bear River Water Conservancy District

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

Copy: Engineer

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

This Agreement is by and between Bear River Water Conservancy District ("Owner") and _____. ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: Harper Ward Well Equipping Project.

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Installing a CMU well house, interior well piping and equipment, well pump and motor in an existing well casing, HVAC system, electrical system, standby generator, buried piping, concrete work, site grading, and connection to existing piping.

ARTICLE 3—ENGINEER

3.01 The Owner has retained J-U-B Engineers, Inc. ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

3.02 The part of the Project that pertains to the Work has been designed by Engineer.

ARTICLE 4—CONTRACT TIMES

4.01 *Time is 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.

4.02 *Contract Times: Dates*

A. The Work will be substantially complete on or before **November 21, 2025** and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before **December 12, 2025**.

4.03 Deleted

4.04 Deleted

4.05 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner $**1,000** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.

2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner $**1,000** for each day that expires after such time until the Work is completed and ready for final payment.

3. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.

B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

C. *Deleted*

ARTICLE 5—CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts that follow, subject to adjustment under the Contract:

A. Deleted

B. Deleted

C. Deleted

D. For all Work, at the prices stated in Contractor's Bid, attached hereto as an exhibit.

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the **15th** day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1. Prior to Substantial 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 Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.

    a. **95** percent of the value of the Work completed (with the balance being retainage).

        1) *Deleted*

        2) The Owner will hold retainage in an interest bearing PTIF account per SRF funding requirements.

    b. **95** percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage).

B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to **100** percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **200** percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

A. Upon final completion and acceptance of the Work, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

6.04 *Consent of Surety*

A. Owner will not make final payment or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

6.05 *Interest*

A. All amounts not paid when due will bear interest at the rate of **0.0** percent per annum.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

A. The Contract Documents consist of all of the following:

1. This Agreement.
2. Bonds:
    a. Performance bond (together with power of attorney).
    b. Payment bond (together with power of attorney).
3. General Conditions.
4. Supplementary Conditions.
    a. BABAA Requirements
5. Specifications as listed in the table of contents of the project manual (copy of list attached).

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

6. Drawings (not attached but incorporated by reference) consisting of **57** sheets with each sheet bearing the following general title: **Harper Ward Well Equipping.**
7. Drawings listed on the attached sheet index.
8. Addenda (numbers _ to _, inclusive).
9. Exhibits to this Agreement (enumerated as follows):
    a. Contractor's Bid
10. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
    a. Notice to Proceed.
    b. Work Change Directives.
    c. Change Orders.
    d. Field Orders.
    e. Warranty Bond, if any.

B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).

C. There are no Contract Documents other than those listed above in this Article 7.

D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 *Contractor's Representations*

A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:

1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

the Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. 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.
9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.
12. Contractor is familiar with all laws and regulations that may affect cost, progress, and performance of the work, including the **BABAA requirements** as lined out in the supplemental conditions section, contract documents, and specifications.
    a. All products must meet BABAA requirements.
    b. Contractor shall include Manufacturer's Certification for BABAA requirements with all applicable submittals. If a specific manufacture is used in the bidding, a statement that Manufacturer will comply with BABAA must be included with the bid submission. Contractor shall comply with BABAA requirements, including coordination with manufacturers, distributors, and suppliers to correct deficiencies in any BABAA documentation.
    c. Engineer/Architect approval of shop drawings or samples shall include review of BABAA documentation.
    d. Contractor shall certify upon completion that all work and materials have complied with BABAA requirements.
    e. For any change orders, Contractor shall provide BABAA documentation for any new products or materials required by the change.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

f. Installation of materials or products that are not compliant with BABAA requirements shall be considered defective work. Contractor should ensure that Engineer/Architect has an approved Manufacturer's Certification or waiver prior to items being delivered to the project site.

g. By submitting an application for payment, based in whole or in part on furnishing equipment or materials, Contractor certifies that such equipment and materials, to contractor's knowledge, are compliant with BABAA requirements.

8.02 *Contractor's Certifications*

A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:

1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;

2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 *Standard General Conditions*

A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

Owner:	Contractor:
_____ *(typed or printed name of organization)*	_____ *(typed or printed name of organization)*
By: _____ *(individual's signature)*	By: _____ *(individual's signature)*
Date: _____ *(date signed)*	Date: _____ *(date signed)*
Name: _____ *(typed or printed)*	Name: _____ *(typed or printed)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
	*(If **[Type of Entity]** is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)*
Attest: _____ *(individual's signature)*	Attest: _____ *(individual's signature)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
Address for giving notices:	Address for giving notices:
_____	_____
_____	_____
_____	_____
Designated Representative:	Designated Representative:
Name: _____ *(typed or printed)*	Name: _____ *(typed or printed)*
Title: _____ *(typed or printed)*	Title: _____ *(typed or printed)*
Address:	Address:
_____	_____
_____	_____
_____	_____
Phone: _____	Phone: _____
Email: _____	Email: _____
*(If **[Type of Entity]** is a corporation, attach evidence of authority to sign. If **[Type of Entity]** is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)*	License No.: _____ *(where applicable)*
	State: _____

EJCDC® C-520, Agreement between Owner and Contractor for Construction Contract (Stipulated Price).
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

NOTICE TO PROCEED

Owner:	Bear River Water Conservancy District	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	57-22-023
Contractor:		Contractor's Project No.:	
Project:	Harper Ward Well Equipping		
Contract Name:			
Effective Date of Contract:			

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on **[date Contract Times are to start]** pursuant to Paragraph 4.01 of the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement:

The date by which Substantial Completion must be achieved is **[____]**, and the date by which readiness for final payment must be achieved is **[_____]**.

Before starting any Work at the Site, Contractor must comply with the following:

[Note any access limitations, security procedures, or other restrictions]

Owner: _____

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

Date Issued: _____

Copy: Engineer

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

PERFORMANCE BOND

Contractor	**Surety**
Name:	Name:
Address *(principal place of business)*:	Address *(principal place of business)*:
Owner	**Contract**
Name: Bear River Water Conservancy District	Description:
Mailing address:	Harper Ward Well Equipping
102 W Forest St Brigham City, UT 84302	Contract Price:
	Effective Date of Contract:

Bond

Bond Amount:

Date of Bond:

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____	_____
(Full formal name of Contractor)	*(Full formal name of Surety) (corporate seal)*
By: _____	By: _____
(Signature)	*(Signature)(Attach Power of Attorney)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____
Attest: _____	Attest: _____
(Signature)	*(Signature)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond will arise after:

    3.1. The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice may indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 will be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement does not waive the Owner's right, if any, subsequently to declare a Contractor Default;

    3.2. The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

    3.3. The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 does not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

    5.1. Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

    5.2. Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

    5.3. Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

    5.4. Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment, or the Surety has denied liability, in whole or in part, without further notice, the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

   7.1. the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

   7.2. additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

   7.3. liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price will not be reduced or set off on account of any such unrelated obligations. No right of action will accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit will be applicable.

12. Notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted therefrom and provisions conforming to such

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

14. Definitions

    14.1. *Balance of the Contract Price*—The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

    14.2. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

    14.3. *Contractor Default*—Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

    14.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

    14.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

16. Modifications to this Bond are as follows: **[None]**

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

PAYMENT BOND

Contractor	**Surety**
Name:	Name: **[Full formal name of Surety]**
Address *(principal place of business)*:	Address *(principal place of business)*: **[Address of Surety's principal place of business]**
Owner	**Contract**
Name: Bear River Water Conservancy District Mailing address *(principal place of business)*: 102 W Forest St Brigham City, UT 84302	Description *(name and location)*: Harper Ward Well Equipping Contract Price: **[Amount, from Contract]** Effective Date of Contract: **[Date, from Contract]**

Bond

Bond Amount: **[Amount]**

Date of Bond: **[Date]**

(Date of Bond cannot be earlier than Effective Date of Contract)

Modifications to this Bond form:

☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

Contractor as Principal	Surety
_____	_____
(Full formal name of Contractor)	*(Full formal name of Surety) (corporate seal)*
By: _____	By: _____
(Signature)	*(Signature)(Attach Power of Attorney)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____
Attest: _____	Attest: _____
(Signature)	*(Signature)*
Name: _____	Name: _____
(Printed or typed)	*(Printed or typed)*
Title: _____	Title: _____

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond will arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond will arise after the following:

    5.1. Claimants who do not have a direct contract with the Contractor

        5.1.1. have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

        5.1.2. have sent a Claim to the Surety (at the address described in Paragraph 13).

    5.2. Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

    7.1. Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

    7.2. Pay or arrange for payment of any undisputed amounts.

    7.3. The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 will not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

8. The Surety's total obligation will not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond will be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract will be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfying obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action will be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit will be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. Definitions

    16.1. *Claim*—A written statement by the Claimant including at a minimum:

        16.1.1. The name of the Claimant;

        16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

        16.1.3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;

        16.1.4. A brief description of the labor, materials, or equipment furnished;

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;

16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;

16.1.7. The total amount of previous payments received by the Claimant; and

16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2. *Claimant*—An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond is to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3. *Construction Contract*—The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4. *Owner Default*—Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5. *Contract Documents*—All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.

18. Modifications to this Bond are as follows: **[Describe modification or enter "None"]**

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	Bear River Water Conservancy District	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	57-22-023
Contractor:		Contractor's Project No.:	
Project:	Harper Ward Well Equipping Project		
Contract Name:			

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:
☐ All Work ☐ The following specified portions of the Work:

[Include applicable work]

Date of Substantial Completion: **TBD**

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☐ None ☐ As follows:

[List amendments to Owner's Responsibilities]

Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

[List amendments to Contractor's Responsibilities]

The following documents are attached to and made a part of this Certificate:

[List attachments such as punch list; other documents]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

EJCDC® C-625, Certificate of Substantial Completion.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*

a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract.

b. A demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal, or seeking resolution of a contractual issue that Engineer has declined to address.

c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.

d. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents.

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.

21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions, including sending and receipt; (c) printing of the transmitted Electronic Document by the

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.

23. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

24. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto.

    a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.

    b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.

    c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.

25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

27. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date, or by a time prior to Substantial Completion of all the Work.

28. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

29. *Notice to Proceed*—A 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 the Work.

30. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor's plan to accomplish the Work within the Contract Times.

32. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.

34. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals.

36. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

37. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

38. *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, and such other lands or areas furnished by Owner which are designated for the use of Contractor.

39. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

40. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers' instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.

42. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion of such Work.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.

44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

45. *Supplier*—A manufacturer, fabricator, supplier, distributor, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

46. *Technical Data*

    a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.

    b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.

    c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.

47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.

48. *Unit Price Work*—Work to be paid for on the basis of unit prices.

49. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

50. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1.02 *Terminology*

A. The words and terms discussed in Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*: The Contract Documents include the terms "as allowed," "as approved," "as ordered," "as directed" or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives "reasonable," "suitable," "acceptable," "proper," "satisfactory," or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

C. *Day*: The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*: The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

1. does not conform to the Contract Documents;

2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

3. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or Paragraph 15.04).

E. *Furnish, Install, Perform, Provide*

1. The word "furnish," when used in connection with services, materials, or equipment, means to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, means to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, means to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

F. *Contract Price or Contract Times*: References to a change in "Contract Price or Contract Times" or "Contract Times or Contract Price" or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term "or both" is not expressed.

G. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Performance and Payment Bonds; Evidence of Insurance*

A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).

B. *Evidence of Contractor's Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.

C. *Evidence of Owner's Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work, and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other Submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.

B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the Electronic Documents.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one Contract Document is as binding as if required by all.

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.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will 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.

G. Nothing in the Contract Documents creates:

1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or

2. any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity, except as may otherwise be required by Laws and Regulations.

3.02 *Reference Standards*

A. *Standards Specifications, Codes, Laws and Regulations*

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, means the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner or Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer in writing all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly notify Owner and Contractor in writing that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. 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 or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein precludes Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the 30th day after the Effective Date of the Contract or, if a Notice to Proceed is given, 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 Contract. In no event will the Contract Times commence to run later than the 60th day after the day of Bid opening or the 30th day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work may be done at the Site prior to such date.

4.03 *Reference Points*

A. Owner shall 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, shall protect and preserve the

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument 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 or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times must be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work will be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Such an adjustment will be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. Severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

2. Abnormal weather conditions;

3. Acts or failures to act of third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and

4. Acts of war or terrorism.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:

1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.

2. Contractor shall not be entitled to an adjustment in Contract Price for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.

3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.

E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:

1. The circumstances that form the basis for the requested adjustment;

2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;

3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;

4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and

5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

F. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5, together with the provisions of Paragraphs 4.05.D and 4.05.E.

G. Paragraph 8.03 addresses delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor in writing of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

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.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas, or to improvements, structures, utilities, or similar facilities located at such adjacent lands or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or in a court of competent jurisdiction; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris will conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: 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 structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;

2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and

3. Technical Data contained in such reports and drawings.

B. *Underground Facilities*: Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.

C. *Reliance by Contractor on Technical Data*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b.

D. *Limitations of Other Data and Documents*: Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;

3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or

4. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate;

2. is of such a nature as to require a change in the Drawings or Specifications;

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine whether it is necessary for Owner to obtain additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

E. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. Such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

c. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise;

b. The existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:

1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

2. complying with applicable state and local utility damage prevention Laws and Regulations;

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;

4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

5. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated on the Drawings, or was not shown or indicated on the Drawings with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing regarding such Underground Facility.

C. *Engineer's Review*: Engineer will:

1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;

2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;

3. obtain any pertinent cost or schedule information from Contractor; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and

4. advise Owner in writing of Engineer's findings, conclusions, and recommendations.

During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Early Resumption of Work*: If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.

F. *Possible Price and Times Adjustments*

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

or indicated on the Drawings, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

a. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and

c. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, then any such adjustment will be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;

2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

of construction to be employed by Contractor, and safety precautions and programs incident thereto;

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly 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 condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.

H. If, after receipt of such 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

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court, arbitration, or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of Contractor's obligations under the Contract. These bonds must remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.

B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.

C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.

E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.

F. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.

H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this article and in the Supplementary Conditions.

B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized in the state or jurisdiction in which the Project is located to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Alternative forms of insurance coverage, including but not limited to self-insurance and "Occupational Accident and Excess Employer's Indemnity Policies," are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.

D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.

E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.

F. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, will not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner's option, may purchase and maintain Owner's own liability insurance. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

H. Contractor shall require:

1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and

2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.

I. If either party does not purchase or maintain the insurance required of such party by the Contract, 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.

J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.

K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) 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 the Contract Price will be adjusted accordingly.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.

M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.

N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, or renewal refused, until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured and Engineer.

6.03 *Contractor's Insurance*

A. *Required Insurance*: Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.

B. *General Provisions*: The policies of insurance required by this Paragraph 6.03 as supplemented must:

1. include at least the specific coverages required;

2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;

3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract;

4. apply with respect to the performance of the Work, whether such performance is 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; and

5. include all necessary endorsements to support the stated requirements.

C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:

1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;

2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;

3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

4. not seek contribution from insurance maintained by the additional insured; and

5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

6.04 *Builder's Risk and Other Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.

B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.

C. *Property Insurance for Substantially Complete Facilities*: Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work, as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.

E. *Insurance of Other Property; Additional Insurance*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.04, it may do so at Contractor's expense.

6.05 *Property Losses; Subrogation*

A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors.

1. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, 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, risks, or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused.
2. None of the above waivers extends to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.

C. The waivers in this Paragraph 6.05 include the waiver of rights due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other insured peril, risk, or cause of loss.

D. Contractor shall be responsible for assuring that each Subcontract contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

6.06 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.04 shall maintain such proceeds in a segregated account, and distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

7.02 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, 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.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.03 *Labor; Working Hours*

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 maintain good discipline and order at the Site.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.

C. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site will be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.04 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

B. All materials and equipment incorporated into the Work must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment must be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.05 *"Or Equals"*

A. *Contractor's Request; Governing Criteria*: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item 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 is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that 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, Engineer will deem it an "or equal" item. For the purposes of this paragraph, 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 the proposed item:

1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

2) will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) has a proven record of performance and availability of responsive service; and

4) is not objectionable to Owner.

b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) the item will conform substantially to the detailed requirements of the item named in the Contract Documents.

B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal," which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request will result in any change in Contract Price. The Engineer's denial of an "or-equal" request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

7.06 *Substitutes*

A. *Contractor's Request; Governing Criteria*: Unless the specification or description of an item of equipment or material required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material under the circumstances described below. To the extent possible such requests must be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of equipment or material from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

3. Contractor shall 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:

    a. will certify that the proposed substitute item will:

        1) perform adequately the functions and achieve the results called for by the general design;

        2) be similar in substance to the item specified; and

        3) be suited to the same use as the item specified.

    b. will state:

        1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times;

        2) whether 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 other work on the Project) to adapt the design to the proposed substitute item; and

        3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

    c. will identify:

        1) all variations of the proposed substitute item from the item specified; and

        2) available engineering, sales, maintenance, repair, and replacement services.

    d. will contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

7.07 *Concerning Subcontractors and Suppliers*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

B. Contractor shall retain specific Subcontractors and Suppliers for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor or Supplier to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within 5 days.

E. Owner may require the replacement of any Subcontractor or Supplier. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors or Suppliers for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.

F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor or Supplier, whether initially or as a replacement, will constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

H. On a monthly basis, Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.

J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.

K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.

L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

7.08 *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 an invention, design, process, product, or device is specified in the Contract Documents 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 will be disclosed in the Contract Documents.

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to 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 specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to 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.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

7.09 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. 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 the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

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

7.11 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

C. Owner or Contractor may give written notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.12 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

7.13 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations.

B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.

C. 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 persons on the Site or who may be affected by the Work;

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, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (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 any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

E. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection.

F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.

G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.

H. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).

J. Contractor's duties and responsibilities for safety and protection will resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as material safety data sheets) or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent 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 by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

1. Before submitting a Shop Drawing or Sample, Contractor shall:

a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determine and verify:

1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;

2) the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;

c. confirm that the Submittal is complete with respect to all related data included in the Submittal.

2. Each Shop Drawing or Sample must bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that Submittal, and that Contractor approves the Submittal.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

3. With each Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

1. *Shop Drawings*

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings must be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide, and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.C.

2. *Samples*

a. Contractor shall submit the number of Samples required in the Specifications.

b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the Submittal for the limited purposes required by Paragraph 7.16.C.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Engineer's Review of Shop Drawings and Samples*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of 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 means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

document any such approved variation from the requirements of the Contract Documents in a Field Order or other appropriate Contract modification.

5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, will not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

7. Neither Engineer's receipt, review, acceptance, or approval of a Shop Drawing or Sample will result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.C.4.

D. *Resubmittal Procedures for Shop Drawings and Samples*

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous Submittals.

2. Contractor shall furnish required Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

E. *Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:

   a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.

   b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.

   c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.

2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03. 2.04, and 2.05.

F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee.

B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:

1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and

2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.

C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, or improper modification, maintenance, or operation, by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:

1. Observations by Engineer;

2. Recommendation by Engineer or payment by Owner of any progress or final payment;

3. The issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. Use or occupancy of the Work or any part thereof by Owner;

5. Any review and approval of a Shop Drawing or Sample submittal;

6. The issuance of a notice of acceptability by Engineer;

7. The end of the correction period established in Paragraph 15.08;

8. Any inspection, test, or approval by others; or

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

9. Any correction of defective Work by Owner.

E. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract will govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from losses, damages, costs, and judgments (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will 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, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.

B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19;

2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and

3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. An itemization of the specific matters to be covered by such authority and responsibility; and

3. The extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.

2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The 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.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *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.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or 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 generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, 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.

10.03 *Resident Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.

B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

A. Engineer has the authority to reject Work in accordance with Article 14.

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

D. Engineer's authority as to changes in the Work is set forth in Article 11.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. 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 the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. 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 Contractor under Paragraph 15.06.A, 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.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

A. 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, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:

1. A mutually acceptable fixed fee; or

2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;

b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;

c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;

d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and

f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

11.08 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

    a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.

    b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

    The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety 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), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:

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 in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any 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 and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.

5. Other costs consisting of 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. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

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.

1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.

3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as 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) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages 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 include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

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. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. 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). Engineer's written decision

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then 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, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *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 perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or 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, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (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.

2. If payment is requested on the basis of materials and equipment 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 must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, 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.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work;

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;

    d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

    e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

    a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. The Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. The Contract Price has been reduced by Change Orders;

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, 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 the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed 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 usable part of the Work that can be used by Owner for its intended purpose without

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. 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 15.03 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.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly 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, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

d. a list of all duly pending Change Proposals and Claims; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Final Application and Recommendation of Payment*: 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 as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment 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 for Payment.

C. *Notice of Acceptability*: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.

D. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas;
2. correct such defective Work;
3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. 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.

E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. 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, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;

2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract 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.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto 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 the Contract. 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.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination of the Contract or of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Assignment of Contract*

A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is 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.

18.09 *Successors and Assigns*

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

18.10 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

TABLE OF CONTENTS

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added—for example, "Paragraph SC-4.05."

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Add the following to Section 1.01 Defined Terms:*

A. "Build America, Buy America Act (BABAA) – Requirements instituted by the Bipartisan Infrastructure Law of 2021 mandating domestic preference that all iron and steel, manufactured products, and construction materials are produced in the United States."

B. "Construction Materials – Those articles, materials, or supply – other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives – that are or consist primarily of: non-ferrous metals, plastic and polymer-based products, glass, lumber or drywall."

C. "Manufactured Product – Items assembled out of components, or otherwise made or processed from raw materials into finished products. Manufactured products must be manufactured (assembled) in the United States, and the cost of components that were mined, produced, or manufactured in the United States must be greater than 55 percent of the total cost of all components of the project."

D. "Manufacturer's Certification – Documentation provided by a Manufacturer, certifying that the items provided by Manufacturer meet the domestic preference requirements of BABAA."

ARTICLE 2—PRELIMINARY MATTERS

2.02 *Copies of Documents*

SC-2.02 Delete Paragraph 2.02.A in its entirety and insert the following new paragraph in its place:

A. Owner shall furnish to Contractor **one** printed copies of conformed Contract Documents incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully signed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies of the conformed Contract Documents will be furnished upon request at the cost of reproduction.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

No suggested Supplementary Conditions in this Article.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.05 *Delays in Contractor's Progress*

SC-4.05 Amend Paragraph 4.05.C by adding the following subparagraphs:

5. *Weather-Related Delays*

a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled.

b. The existence of abnormal weather conditions will be determined on a month-by-month basis in accordance with the following:

1) Every workday on which one or more of the following conditions exist will be considered a "bad weather day":

i) Total precipitation (as rain equivalent) occurring between 7:00 p.m. on the preceding day (regardless of whether such preceding day is a workday) through 7:00 p.m. on the workday in question equals or exceeds **one inch** of precipitation (as rain equivalent, based on the snow/rain conversion indicated in the table entitled Foreseeable Bad Weather Days; such table is hereby incorporated in this SC-4.05.C by reference.

ii) Ambient outdoor air temperature at 11:00 a.m. is equal to or less than the following low temperature threshold: **-10** degrees Fahrenheit; or, at 3:00 p.m. the ambient outdoor temperature is equal to or greater than the following high temperature threshold: **110** degrees Fahrenheit.

2) Determination of actual bad weather days during performance of the Work will be based on the weather records measured and recorded by **Smithfield – KUTSMITH14** weather monitoring station at **41.84° N and 111.83° W**.

3) Contractor shall anticipate the number of foreseeable bad weather days per month indicated in the table in Exhibit **A**—Foreseeable Bad Weather Days.

4) In each month, every bad weather day exceeding the number of foreseeable bad weather days established in the table in Exhibit **A**—Foreseeable Bad Weather Days will be considered as "abnormal weather conditions." The existence of abnormal weather conditions will not relieve Contractor of the obligation to demonstrate and document that delays caused by abnormal weather are specific to the planned work activities or that such activities thus delayed were on Contractor's then-current Progress Schedule's critical path for the Project.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 5—SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS

5.03 *Subsurface and Physical Conditions*

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D:

E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
N/A	N/A	N/A

F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
N/A	N/A	N/A

5.06 *Hazardous Environmental Conditions*

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely:

Report Title	Date of Report	Technical Data
N/A	N/A	N/A

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
N/A	N/A	N/A

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.A:

1. *Required Performance Bond Form:* The performance bond that Contractor furnishes will be in the form of EJCDC® C-610, Performance Bond (2010, 2013, or 2018 edition).

2. *Required Payment Bond Form:* The payment bond that Contractor furnishes will be in the form of EJCDC® C-615, Payment Bond (2010, 2013, or 2018 edition).

6.03 *Contractor's Insurance*

SC-6.03 Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.C:

D. *Other Additional Insureds:* As a supplement to the provisions of Paragraph 6.03.C of the General Conditions, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following: **No other additional insured**

E. *Workers' Compensation and Employer's Liability:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance, including, as applicable, United States Longshoreman and Harbor Workers' Compensation Act, Jones Act, stop-gap employer's liability coverage for monopolistic states, and foreign voluntary workers' compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

Workers' Compensation and Related Policies	**Policy limits of not less than:**
Workers' Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory
Jones Act (if applicable)	
Bodily injury by accident—each accident	$
Bodily injury by disease—aggregate	$
Employer's Liability	
Each accident	$1,000,000
Each employee	$1,000,000
Policy limit	$1,000,000
Stop-gap Liability Coverage	
For work performed in monopolistic states, stop-gap liability coverage must be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of:	$1,000,000

F. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,

2. damages insured by reasonably available personal injury liability coverage, and

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage.

a. Such insurance must be maintained for three years after final payment.

b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.

2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.

3. Severability of interests and no insured-versus-insured or cross-liability exclusions.

4. Underground, explosion, and collapse coverage.

5. Personal injury coverage.

6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.

7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).

2. Any exclusion for water intrusion or water damage.

3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.

4. Any exclusion of coverage relating to earth subsidence or movement.

5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).

6. Any limitation or exclusion based on the nature of Contractor's work.

7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	$2,000,000
Products—Completed Operations Aggregate	$1,000,000
Personal and Advertising Injury	$1,000,000
Bodily Injury and Property Damage—Each Occurrence	$1,000,000

J. *Automobile Liability:* Contractor shall purchase and maintain automobile liability insurance 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. The automobile liability policy must be written on an occurrence basis.

Automobile Liability	Policy limits of not less than:
Bodily Injury	
Each Person	$2,000,000
Each Accident	$2,000,000
Property Damage	
Each Accident	$2,000,000
[or]	
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	$2,000,000

K. *Umbrella or Excess Liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

Excess or Umbrella Liability	Policy limits of not less than:
Each Occurrence	$2,000,000
General Aggregate	$2,000,000

L. *Deleted*

M. *Contractor's Pollution Liability Insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance must be maintained for no less than three years after final completion.

Contractor's Pollution Liability	Policy limits of not less than:
Each Occurrence/Claim	$N/A
General Aggregate	$N/A

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

N. *Contractor's Professional Liability Insurance:* If Contractor will provide or furnish professional services under this *Contract*, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Contractor's Professional Liability	**Policy limits of not less than:**
Each Claim	$N/A
Annual Aggregate	$N/A

O. *Railroad Protective Liability Insurance:* Prior to commencing any Work within 50 feet of railroad-owned and controlled property, Contractor shall (1) endorse its commercial general liability policy with ISO CG 24 17, removing the contractual liability exclusion for work within 50 feet of a railroad, (2) purchase and maintain railroad protective liability insurance meeting the following requirements, (3) furnish a copy of the endorsement to Owner, and (4) submit a copy of the railroad protective policy and other railroad-required documentation to the railroad, and notify Owner of such submittal.

[Insert additional specific requirements, commonly set by the railroad, here.]

Railroad Protective Liability Insurance	**Policy limits of not less than:**
Each Claim	$N/A
Aggregate	$N/A

P. *Unmanned Aerial Vehicle Liability Insurance:* If Contractor uses unmanned aerial vehicles (UAV—commonly *referred* to as drones) at the Site or in support of any aspect of the Work, Contractor shall obtain UAV liability insurance in the amounts stated; name Owner, Engineer, and all individuals and entities identified in the Supplementary Conditions as additional insureds; and provide a certificate to Owner confirming Contractor's compliance with this requirement. Such insurance will provide coverage for property damage, bodily injury or death, and invasion of privacy.

Unmanned Aerial Vehicle Liability Insurance	**Policy limits of not less than:**
Each Claim	$N/A
General Aggregate	$N/A

Q. *Other Required Insurance:* **None**

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

6.04 *Builder's Risk and Other Property Insurance*

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:

F. *Builder's Risk Requirements:* The builder's risk insurance must:

1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).

    a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.

    b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to Owner and Contractor.

2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

3. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of contractors, engineers, and architects).

4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier). If this coverage is subject to a sublimit, such sublimit will be a minimum of $**500,000**.

5. extend to cover damage or loss to insured property while in transit. If this coverage is subject to a sublimit, such sublimit will be a minimum of $**500,000**.

6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.

7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.

8. include performance/hot testing and start-up, if applicable.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

9. be maintained in effect until the Work is complete, as set forth in Paragraph 15.06.D of the General Conditions, or until written confirmation of Owner's procurement of property insurance following Substantial Completion, whichever occurs first.

10 include as named insureds the Owner, Contractor, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds." In addition to Owner, Contractor, and Subcontractors of every tier, include as insureds the following:

a. **None**

11. include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties:

a. **None**

12. If debris removal in connection with repair or replacement of insured property is subject to a coverage sublimit, such sublimit will be a minimum of $**500,000**.

13. In addition to the coverage sublimits stated above, the following coverages are also subject to sublimits, as follows:

a. **None**

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.03 *Labor; Working Hours*

SC-7.03 Delete Paragraph 7.03.C in its entirety, and insert the following:

C. In the absence of any Laws or Regulations to the contrary, Contractor may perform the Work on holidays, during any or all hours of the day, and on any or all days of the week, at Contractor's sole discretion.

SC-7.03 Add the following new paragraph immediately after Paragraph 7.03.C:

D. Owner shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer's services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

ARTICLE 8—OTHER WORK AT THE SITE

No suggested Supplementary Conditions in this Article.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 9—OWNER'S RESPONSIBILITIES

No suggested Supplementary Conditions in this Article.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.03 *Resident Project Representative*

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.B:

C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:

1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.

2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.

3. *Liaison*

   a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

   b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.

   c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.

4. *Review of Work; Defective Work*

   a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.

   b. Observe whether any Work in place appears to be defective.

   c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.

5. *Inspections and Tests*

   a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.

   b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

6. *Payment Requests:* Review Applications for Payment with Contractor.

7. *Completion*

   a. Participate in Engineer's visits regarding Substantial Completion.

   b. Assist in the preparation of a punch list of items to be completed or corrected.

   c. Participate in Engineer's visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.

   d. Observe whether items on the final punch list have been completed or corrected.

D. The RPR will not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction.

5 Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.

7. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 11—CHANGES TO THE CONTRACT

No suggested Supplementary Conditions in this Article.

ARTICLE 12—CLAIMS

No suggested Supplementary Conditions in this Article.

ARTICLE 13—COST OF WORK; ALLOWANCES, UNIT PRICE WORK

13.01 *Cost of the Work*

SC-13.01 Supplement Paragraph 13.01.B.5.c.(2) by adding the following sentence:

The equipment rental rate book that governs the included costs for the rental of machinery and equipment owned by Contractor (or a related entity) under the Cost of the Work provisions of this Contract is the most current edition of **Rental Rate Blue Book for Construction Equipment**.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

SC-13.01 Supplement Paragraph 13.01.C.2 by adding the following definition of small tools and hand tools:

a. For purposes of this paragraph, "small tools and hand tools" means any tool or equipment whose current price if it were purchased new at retail would be less than $500.

13.03 *Unit Price Work*

SC-13.03 Delete Paragraph 13.03.E in its entirety and insert the following in its place:

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the extended price of a particular item of Unit Price Work amounts to **5** percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than 20 percent from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCCEPTANCE OF DEFECTIVE WORK

No suggested Supplementary Conditions in this Article.

ARTICLE 15—PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

15.03 *Substantial Completion*

SC-15.03 Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

No suggested Supplementary Conditions in this Article.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

17.02 *Arbitration*

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

17.02 *Arbitration*

A. All matters subject to final resolution under this Article will be settled by arbitration administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules (subject to the conditions and limitations of this Paragraph SC-17.02). Any controversy or claim in the amount of $100,000 or less will be settled in accordance with the American Arbitration Association's supplemental rules for Fixed Time and Cost Construction Arbitration. This agreement to arbitrate will be specifically enforceable under the prevailing law of any court having jurisdiction.

B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitration administrator, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in Article 17, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event will any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations.

C. The arbitrator(s) must be licensed engineers, contractors, attorneys, or construction managers. Hearings will take place pursuant to the standard procedures of the Construction Arbitration Rules that contemplate in-person hearings. The arbitrators will have no authority to award punitive or other damages not measured by the prevailing party's actual damages, except as may be required by statute or the Contract. Any award in an arbitration initiated under this clause will be limited to monetary damages and include no injunction or direction to any party other than the direction to pay a monetary amount.

D. The Arbitrators will have the authority to allocate the costs of the arbitration process among the parties, but will only have the authority to allocate attorneys' fees if a specific Law or Regulation or this Contract permits them to do so.

E. The award of the arbitrators must be accompanied by a reasoned written opinion and a concise breakdown of the award. The written opinion will cite the Contract provisions deemed applicable and relied on in making the award.

F. The parties agree that failure or refusal of a party to pay its required share of the deposits for arbitrator compensation or administrative charges will constitute a waiver by that party to present evidence or cross-examine witness. In such event, the other party shall be required to present evidence and legal argument as the arbitrator(s) may require for the making of an award. Such waiver will not allow for a default judgment against the non-paying party in the absence of evidence presented as provided for above.

G. No arbitration arising out of or relating to the Contract will include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

1. the inclusion of such other individual or entity will allow complete relief to be afforded among those who are already parties to the arbitration;

2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration, and which will arise in such proceedings;

3. such other individual or entity is subject to arbitration under a contract with either Owner or Contractor, or consents to being joined in the arbitration; and

4. the consolidation or joinder is in compliance with the arbitration administrator's procedural rules.

H. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.

I. Except as may be required by Laws or Regulations, neither party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of both parties, with the exception of any disclosure required by Laws and Regulations or the Contract. To the extent any disclosure is allowed pursuant to the exception, the disclosure must be strictly and narrowly limited to maintain confidentiality to the extent possible.

ARTICLE 18—MISCELLANEOUS

18.01 *Add the following requirement:*

A. "Domestic Preference: Iron and steel products, Manufactured Products, and Construction Materials used in this project comply with the Build America, Buy America Act (BABAA) requirements mandated by Title IX of the Infrastructure Investment and Jobs Act ("IIJA"), Pub. L. 177-58."

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

EXHIBIT A—FORESEEABLE BAD WEATHER DAYS

Month	Number of Foreseeable Bad Weather Days in Month Based on Precipitation as Rain Equivalent (inches) (1)	Ambient Outdoor Air Temperature (degrees F)	
		Number of Foreseeable Bad Weather Days in Month Based on Low Temperature (at 11:00 a.m.)	Number of Foreseeable Bad Weather Days in Month Based on High Temperature (at 3:00 p.m.)
January	0	0	0
February	0	0	0
March	0	0	0
April	0	0	0
May	0	0	0
June	0	0	0
July	0	0	0
August	0	0	0
September	0	0	0
October	0	0	0
November	0	0	0
December	0	0	0

Notes:

1. Two inches of sleet equal one inch of rain. Five inches of wet, heavy snow equal one inch of rain. Fifteen inches of “dry” powder snow equals one inch of rain.

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

WORK CHANGE DIRECTIVE NO.: [Number of Work Change Directive]

Owner:	Bear River Water Conservancy District	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	57-22-023
Contractor:		Contractor's Project No.:	
Project:	Harper Ward Well Equipping		
Contract Name:			
Date Issued:		Effective Date of Work Change Directive:	

Contractor is directed to proceed promptly with the following change(s):

Description:

[Description of the change to the Work]

Attachments:

[List documents related to the change to the Work]

Purpose for the Work Change Directive:

[Describe the purpose for the change to the Work]

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Notes to User—Check one or both of the following

☐ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: $ _____ **[increase] [decrease] [not yet estimated]**.

Contract Time: _____ days **[increase] [decrease] [not yet estimated]**.

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

	Recommended by Engineer	Authorized by Owner
By:	_____	_____
Title:	_____	_____
Date:	_____	_____

EJCDC® C-940, Work Change Directive.
Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies, and American Society of Civil Engineers. All rights reserved.

CHANGE ORDER NO.: [Number of Change Order]

Owner:	Bear River Water Conservancy District	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	57-22-023
Contractor:		Contractor's Project No.:	
Project:	Harper Ward Well Equipping		
Contract Name:			
Date Issued:		Effective Date of Change Order:	

The Contract is modified as follows upon execution of this Change Order:

Description:

[Description of the change]

Attachments:

[List documents related to the change]

Change in Contract Price	**Change in Contract Times [State Contract Times as either a specific date or a number of days]**
Original Contract Price: $ _____	Original Contract Times: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. **[Number of previous Change Order]**: $ _____	**[Increase] [Decrease]** from previously approved Change Orders No.1 to No. **[Number of previous Change Order]**: Substantial Completion: _____ Ready for final payment: _____
Contract Price prior to this Change Order: $ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] this Change Order: $ _____	**[Increase] [Decrease]** this Change Order: Substantial Completion: _____ Ready for final payment: _____
Contract Price incorporating this Change Order: $ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for final payment: _____

	Recommended by Engineer (if required)	Authorized by Owner
By:	_____	_____
Title:	_____	_____
Date:	_____	_____

	Authorized by Owner	Approved by Funding Agency (if applicable)
By:	_____	_____
Title:	_____	_____
Date:	_____	_____

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies and American Society of Civil Engineers. All rights reserved.

FIELD ORDER NO.: [Number of Field Order]

Owner:	Bear River Water Conservancy District	Owner's Project No.:	
Engineer:	J-U-B Engineers, Inc.	Engineer's Project No.:	57-22-023
Contractor:		Contractor's Project No.:	
Project:	Harper Ward Well Equipping		
Contract Name:			
Date Issued:		Effective Date of Field Order:	

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with Paragraph 11.04 of the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:

[Description of the change to the Work]

Attachments:

[List documents supporting change]

Issued by Engineer

By: _____

Title: _____

Date: _____

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies and American Society of Civil Engineers. All rights reserved.

THIS PAGE INTENTIONALLY LEFT BLANK

Copyright© 2018 National Society of Professional Engineers, American Council of Engineering Companies and American Society of Civil Engineers. All rights reserved.

TECHNICAL SPECIFICATIONS

FOR

BEAR RIVER WATER CONSERVANCY DISTRICT

HARPER WARD WELL EQUIPPING PROJECT

DECEMBER 2024

Project No. 57-22-023

1047 South 100 West, Suite 201, Logan, UT 84321
p 435 713 9514 f 801 547 0397 w www.jub.com

OTHER J-U-B COMPANIES THE LANGDON GROUP GATEWAY MAPPING INC.

NOTICE AND DISCLAIMER

J-U-B grants to CLIENT a nonexclusive, non-transferable license to use the Drawings, Specifications and/or Contract Documents (Documents) as follows:

CLIENT may make and retain copies of the Documents for reference, but J-U-B shall retain all common law, statutory and other reserved rights, including the copyright thereto, and the same shall not be reused on this Project or any other Project without J-U-B's prior written consent. Distribution of Documents to meet regulatory or permitting requirements, or for similar purposes, in connection with the Project, including but not limited to distribution to contractors or subcontractors for the performance of their work, is not to be construed as publication adversely affecting the reserved rights of J-U-B. The Documents are not intended for use in creating dtm for grading or earthwork, survey staking layout (unless specifically identified as such in the documents), or property boundary layouts.

Any reuse without written consent by J-U-B, or without verification or adoption by J-U-B for the specific purpose intended by the reuse, will be at CLIENT's sole risk and without liability or legal exposure to J-U-B. The CLIENT shall release, defend, indemnify, and hold J-U-B harmless from any claims, damages, actions or causes of action, losses, and expenses, including reasonable attorneys' and expert fees, arising out of or resulting from such reuse.
If the Documents are provided in electronic format, the electronic documents are subject to the provisions of J-U-B's "electronic document/data limited license" found at edocs.jub.com.

Page intentionally left blank

HARPER WARD WELL EQUIPPING PROJECT

TABLE OF CONTENTS

DIVISION 26 ELECTRICAL

DIVISION 31 EARTHWORK

DIVISION 32 EXTERIOR IMPROVEMENTS

DIVISION 33 UTILITIES

DIVISION 40 PROCESS INTERCONNECTIONS

DIVISION 46 WATER AND WASTEWATER EQUIPMENT

Included by Reference: Bear River Water Conservancy District 2024 Standard Specifications and Details

Additional Notes: Reference the Bear River Water Conservancy District 2024 Standard Specifications and Details for items not included within the Table of Contents listed above. If there is any discrepancy, conflict

or inconsistency within the Technical Specifications themselves, the Contractor shall provide the better-quality Work or Materials product, unless Owner or Engineer directs otherwise in writing.

SECTION 00 81 00
SPECIAL CONDITIONS

PART 1 GENERAL

1.1 The Project is partially funded with a WaterSMART Reclamation Program Grant through the Bureau of Reclamation. All bidders are required to take affirmative steps to assure compliance with the Uniform Administrative Requirement, Cost Principles, and Audit Requirements for Federal Awards as applicable. These conditions are in addition to all other bid requirements and are outlined in this Section.

1.2 The Project also requires adherence to the State of Utah State Revolving Fund (SRF) special conditions. These conditions are in addition to all other bid requirements and are outlined in this Section.

PART 2 BUREAU OF RECLAMATION CONDITIONS

2.1 **Contracting with small and minority businesses, women's business enterprises, and labor surplus area firms.**

A. The CONTRACTOR must take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used when possible.

B. Affirmative steps must include:

1. Placing qualified small and minority businesses and women's business enterprises on solicitation lists;

2. Assuring that small and minority businesses, and women's business enterprises are solicited whenever they are potential sources;

3. Dividing total requirements, when economically feasible, into smaller tasks or quantities to permit maximum participation by small and minority businesses, and women's business enterprises;

4. Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises;

5. Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce; and

6. Requiring the prime contractor, if subcontracts are to be let, to take the affirmative steps listed in paragraphs (b)(1) through (5) of this section.

2.2 **Domestic Preferences for Procurements.**

A. As appropriate and to the extent consistent with law, the CONTRACTOR should, to the greatest extent practicable under a Federal award, provide a preference for the purchase, acquisition, or use of goods, products, or materials produced in the United States

(including but not limited to iron, aluminum, steel, cement, and other manufactured products). The requirements of this section must be included in all subawards including all contracts and purchase orders for work or products under this award.

B. For purposes of this section:

1. “Produced in the United States” means, for iron and steel products, that all manufacturing processes, from the initial melting stage through the application of coatings, occurred in the United States.

2. “Manufactured products” means items and construction materials composed in whole or in part of non-ferrous metals such as aluminum, plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber.

PART 3 SRF SPECIAL CONDITIONS

3.1 Contractor shall comply with the following SRF Special Conditions for certification regarding debarment, suspension, ineligibility and voluntary exclusion lower tier covered transactions. The signed certification shall be submitted with the Contractor’s bid.

SRF SPECIAL CONDITIONS

CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION LOWER TIER COVERED TRANSACTIONS

Instructions for Certification

1. By signing and submitting this proposal, the prospective lower tier participant is providing the certification set out below.

2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

3. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or had become erroneous by reason of changed circumstances.

4. The terms covered transaction, debarred, suspended, ineligible, lower tier covered transaction, participant, person, primary covered transaction, principal, proposal, and voluntarily excluded, as used in this clause, have the meaning set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.

5. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is proposed for debarment under 48 CFR part 9, subpart 9.4, debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

6. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

7. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that it is not proposed for debarment under 48 CFR part 9, subpart 9.4, debarred, suspended, ineligible, or voluntarily excluded from covered transactions, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

8. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

9. Except for transactions authorized under paragraph 5 of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is proposed for debarment under 48 CFR part 9, subpart 9.4, suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Covered Transactions

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

_____

Organization Name

_____

Name and Title of Authorized Representative

_____

Signature

Date

REQUIRED SIGNS AND POSTERS

The following signs and posters required for the project, include but are not limited to:

1.	Minimum Wage Poster	www.dol.gov/agencies/whd/posters/flsa
2.	Equal Opportunity Employer Poster:	www.dol.gov/agencies/ofccp/posters
3.	OSHA Poster	www.osha.gov/publications/poster

PROHIBITION AGAINST
LISTED VIOLATING FACILITIES

A. REQUIREMENTS

(1) To comply with all the requirements of section 114 of the Clean Air Act, as amended (42 U.S.C. 1857, et seq., as amended by Pub. L. 92-604) and section 308 of the Clean Water Act (33 U.S.C. 1251, as amended), respectively, which relate to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, respectively, and all regulations and guidelines issued thereunder before the award of this contract.

(2) That no portion of the work required by this prime contract will be performed in a facility listed on the Environmental Protection Agency list of violating facilities on the date when this contract was awarded unless and until the EPA eliminates the name of such facility or facilities from the listing.

(3) To use his best efforts to comply with clean air and clean water standards at the facilities in which the contract is being performed.

(4) To insert the substance of the provisions of this clause, including this paragraph (4), in any nonexempt subcontract.

B. DEFINITIONS

(1) Air Act means the Clean Air Act, as amended (42 U.S.C. 1857 et seq.).

(2) Water Act means the Clean Water Act, as amended (33 U.S.C. 1251 et seq.).

(3) Clean Air Standards means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted under the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 (d) of the Air Act (42 U.S.C. 1857c-5(d)), an approved implementation procedure or plan under section 111 (c) or section 111(d), or an approved implementation procedure under section 112(d) of the Air Act (42 U.S.C. 1857c-7(d)).

(4) Clean Water Standards means any enforceable limitation, control, condition, prohibition, standard, or other requirement which is promulgated under the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. 1342), or by a local government to ensure compliance with pretreatment regulations as required by section 307 of Water Act (33 U.S.C. 1317).

(5) Compliance means compliance with clean air or water standards. Compliance shall also mean compliance with a schedule or plan ordered or approved by a court of competent

jurisdiction, the Environmental Protection Agency in accordance with the requirements of the Air Act or Water Act and regulations.

(6) Facility means any building, plant, installation, structure, mine, vessel, or other floating craft, location, or site of operations, owned, leased, or supervised by a contractor or subcontractor, to be used in the performance of a contract or subcontract. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location or site shall be deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are located in one geographical area.

WILLIAMS-STEIGER OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

A. AUTHORITY

(1) The contractor is subject to the provisions of the Williams-Steiger Occupational Safety and Health Act of 1970.

(2) These construction documents and the joint and several phases of construction hereby contemplated are to be governed, at all times, by applicable provisions of the Federal law(s), including but not limited to the latest amendment of the following:

a. Williams-Steiger Occupational Safety and Health Act of 1970, Public Law 94-596;

b. Part 1910 - Occupational Safety and Health Standards, Chapter XVII of Title 29, Code of Federal Regulations;

c. Part 1926 - Safety and Health Regulations for Construction, Chapter XVII of Title 29, Code of Federal Regulations.

B. SAFETY AND HEALTH PROGRAM REQUIREMENTS

(1) This project, its prime contractor and its subcontractors, shall at all times be governed by Chapter XVII of Title 29, Code of Federal Regulations, Part 1926 - Safety and Health Regulations for Construction (29 CFR 22801), as amended to date.

(2) To implement the program and to provide safe and healthful working conditions for all persons, general project safety meetings will be conducted at the site at least once each month during the course of construction, by the construction superintendent or his/her designated safety officer. Notice of such meeting shall be issued not less than three (3) days prior, stating the exact time, location, and agenda to be included. Attendance by the owner, architect, general foreman, shop steward(s), and trades, or their designated representatives, witnessed in writing as such, shall be mandatory.

(3) To further implement the program, each trade shall conduct a short gang meeting, not less than once a week, to review project safety requirements mandatory for all persons during the coming week. The gang foreman shall report the agenda and specific items covered to the project superintendent, who shall incorporate these items in his/her daily log or report.

(4) The prime contractor and all subcontractors shall immediately report all accidents, injuries, or health hazards to the owner and architect, or their designated representatives, in writing. This shall not obviate any mandatory reporting under the provisions of the Occupational Safety and Health Act of 1970.

(5) This program shall become a part of the contract documents and the contract between the owner and prime contractor, prime contractor and all subcontractors, as though fully written therein.

ANTI-KICKBACKS

Contractor shall comply with the Copeland "Anti-Kickback" Act (18 U.S.C. 874) as supplemented in the Department of Labor Regulations (29 CFR, Part 3). This Act provides that Contractor is prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he is otherwise entitled.

Contractor certifies and warrants that no gratuities, kickbacks and contingency fees were paid in connection with this contract, nor were any fees, commissions, gifts, or other considerations made contingent upon the award of this contract.

Contractor certifies that, to Contractor's knowledge, no state employee has any personal or beneficial interest whatsoever in the services described in this Contract.

No staff member of Contractor, compensated either partially or wholly with funds disbursed pursuant to the Contract, shall engage in any Contract or activity which would constitute a conflict of interest as related to this Contract.

DISCOVERY OF ARCHAEOLOGICAL AND OTHER HISTORICAL ITEMS

In the event of an archaeological find during any phase of construction, the following procedure will be followed:

1. Construction shall be halted, with as little disruption to the archaeological site as possible.
2. Contractor shall notify Owner who shall contact the State Historic Preservation Officer.
3. The State Historic Preservation Officer may decide to have an archaeologist inspect the site and make recommendations about the steps needed to protect the site, before construction is resumed.
4. The entire event should be handled as expediently as possible in order to hold the loss in construction time to a minimum while still protecting archaeological finds.

A similar procedure should be followed with regard to more recent historical resources. Should any artifacts, housing sites, etc., be uncovered, the same procedure should be followed as for an archaeological find.

In the event archaeological/historical data are evaluated to meet National Register criteria, the Advisory Council on Historic Preservation may be notified and asked to comment by the Utah State Revolving Fund Program.

ACCESS

Contractor and loan recipient shall insure that authorized representatives of the Utah DEQ, State Historic Preservation Office, US EPA, Comptroller General, Inspector General, and other applicable federal and state agencies and officials will have access to the project work whenever it is in preparation or progress and shall provide proper facilities for such access and inspection. Contractor shall allow these representatives to have access to any books, documents, plans, reports, papers, and other records of Contractor which are pertinent to the project for the purpose of making audit, examination, excerpts, copies and transcriptions thereof and to interview any officer or employee. Contractor shall insure that all subagreements will also afford access to such project work, sites, documents, records, and persons.

SITE EROSION AND SEDIMENT CONTROL MEASURES

Every effort shall be made by Contractor and subcontractors to prevent and correct problems associated with erosion and runoff processes which could occur during and after project construction. The efforts should be consistent with applicable local ordinances and the Nonpoint Source Pollution Control Guidance. Whenever appropriate, Contractor's efforts shall reflect the following engineering principles:

(a) When appropriate, land grading and excavating should be kept at a minimum to reduce the possibility of creating runoff and erosion problems which require extensive control measures.
(b) Whenever possible, topsoil should be removed and stockpiled before grading begins.
(c) Land exposure should be minimized in terms of area and time.
(d) Exposed areas subject to erosion should be covered as quickly as possible by means of mulching or vegetation.
(e) Natural vegetation should be retained whenever feasible.
(f) Early completion of stabilized drainage systems (temporary and permanent systems) will substantially reduce erosion potential.
(g) Roadways and parking lots should be paved or otherwise stabilized as soon as feasible.
(h) Clearing and grading should not be started until a firm construction schedule is known and can be effectively coordinated with grading and clearing activity.

UPDES CONSTRUCTION RELATED DISCHARGE PERMITS

Construction projects which will disturb one or more acres will require coverage under the State of Utah General Permit for Storm Water Discharges Associated with Large Construction Activities. Contractor is responsible for obtaining coverage under the appropriate permit and maintaining compliance until Owner accepts the Work as complete. For additional information see http://www.waterquality.utah.gov/UPDES/stormwatercon.htm.

Certain construction activities such as dewatering, flushing, testing, and disinfection require coverage under the State of Utah General Permit for Temporary Discharges or under a separate discharge permit. Contractor is responsible for obtaining any necessary coverage and maintaining compliance. For more information see **http://www.waterquality.utah.gov/UPDES/stormwatercon.htm**.

AIR QUALITY PROTECTION MEASURES

Contractor shall adhere to effective dust control procedures as required under the Utah Air Quality Standards and Regulations UAC R307. If asbestos is encountered during this project, Contractor shall follow standards for handling according to UAC R307-801. Contractor shall adhere to proper trade waste and materials disposal.

PRESERVATION OF OPEN COMPETITION AND GOVERNMENT NEUTRALITY TOWARDS GOVERNMENT CONTRACTORS' LABOR RELATIONS ON FEDERAL AND FEDERALLY FUNDED CONSTRUCTION PROJECTS

The assistance recipient agrees to comply with Executive Order 13202 (Feb. 22, 2001, 66 Federal Register 11225) of February 17, 2001, entitled "Preservation of Open Competition and Government Neutrality Towards Government Contractors' Labor Relations on Federal and Federally Funded Construction Projects," as amended by Executive Order 13208 (April 11, 2001, 66 Federal Register 18717) of April 6, 2001, entitled "Amendment to Executive Order 13202, Preservation of Open Competition and Government Neutrality Towards Government Contractors' Labor Relations on Federal and Federally Funded Construction Projects.

Amend 48 CFR Part 36.202 by adding paragraph (d) to read as follows:

(d) In accordance with Executive Order 13202, of February 17, 2001, Preservation of Open Competition and Government Neutrality Towards Government Contractors' Labor Relations on Federal and Federally Funded Construction Projects, as amended on April 6, 2001—

(1) The Government, or any construction manager acting on behalf of the Government, must not—

(i) Require or prohibit offerors, contractors, or subcontractors to enter into or adhere to agreements with one or more labor organizations (as defined in 42 U.S.C. 2000e(d)) on the same or other related construction projects; or

(ii) Otherwise discriminate against offerors, contractors, or subcontractors for becoming, refusing to become, or remaining signatories or otherwise adhering to agreements with one or more labor organizations, on the same or other related construction projects.

(2) Nothing in this paragraph prohibits offerors, contractors, or subcontractors from voluntarily entering into project labor agreements.

(3) The head of the agency may exempt a construction project from this policy if the agency head finds that, as of February 17, 2001—

(i) The agency or a construction manager acting on behalf of the Government had issued or was a party to bid specifications, project agreements, agreements with one or more labor organizations, or other controlling documents with respect to that particular project, which contained any of the requirements or prohibitions in paragraph (d)(1) of this section; and

(ii) One or more construction contracts subject to such requirements or prohibitions had been awarded.

(4) The head of the agency may exempt a particular project, contract, or subcontract from this policy upon a finding that special circumstances require an exemption in order to avert an imminent threat to public health or safety, or to serve the national security. A finding of "special circumstances" may not be based on the possibility or presence of a labor dispute concerning the use of contractors or subcontractors who are nonsignatories to, or otherwise do not adhere to, agreements with one or more labor organizations, or concerning employees on the project who are not members of or affiliated with a labor organization.

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General Description of Work.

B. Contractor Use of Site and Premises.

C. Work Sequence.

1.2 GENERAL DESCRIPTION OF WORK

A. The Harper Ward Well Equipping Site consists of:
- All piping, valves, and fittings required to construct the well house.
- All earthwork required to grade the site.
- Installation of new water and drain piping.
- Connection to existing piping as directed.

B. The Well House includes:
- Construction of a new CMU well house and new piping and appurtenances.
- Installation of electrical, heating, and air conditioning system.
- Installation of a backup generator and automatic transfer switch that is provided by Owner.
- Sub-contracting and coordination with SCADA provider.

C. The Contractor is required to install and maintain proper signage as required to direct public traffic.

1.3 CONTRACTOR USE OF SITE AND PREMISES

A. Limit use of site and premises to allow:
1. Access by property owners.
2. Work by others authorized by Owner and work by Owner.
3. Use of surrounding site and premises by Owner and other contractors.
4. Work by others.

B. Construction operations are limited to owner property, right-of-way limits, easement boundaries, and as shown on the Plans, unless otherwise authorized in writing by the Owner and Engineer.

C. Time Restrictions for Performing Work. Work shall start no earlier than 7:00 a.m. and shall end no later than 7:00 p.m. Monday through Saturday unless authorized by the Owner.

D. Utility Outages and Shutdown: No culinary water service or fire protection service will be discontinued for a period of more than 8 hours in one 24-hour period.

1.4 WORK SEQUENCE

A. Construct Work in a manner to meet the requirements of Section 1.3 above. During construction period, coordinate construction schedule and operations with Owner and Engineer.

B. Construct Work to allow for review of all trenching and excavation prior to backfilling or other work that would prevent a complete visual inspection of the trench or excavation.

C. Connect the new waterline only at one end until all bacteriological and pressure testing is complete and accepted.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 22 00
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Authority

B. Payment

C. Defect Assessment

D. Non-Payment for Rejected Products

E. General Description of Measurement and Payment

F. Alternates

G. Schedule of Bid Items

1.2 ENGINEER'S AUTHORITY

A. See EJCDC C-700 General Conditions, Article 10

1.3 PAYMENT

A. See EJCDC C-700 General Conditions, Article 15

1.4 DEFECT ASSESSMENT

A. See EJCDC C-700 General Conditions, 10.04 and Article 14

B. The authority of the Engineer to assess the defect and identify payment adjustment is final.

1.5 NON-PAYMENT FOR REJECTED PRODUCTS

A. Payment will not be made for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from the transporting vehicle.
   4. Products placed beyond the lines and levels of the required Work.
   5. Products remaining on hand after completion of the Work.
   6. Loading, hauling and disposing of rejected Products.
   7. Removing rejected materials and/or work and replacing with materials and/or work in compliance with these specifications.

1.6 GENERAL DESCRIPTION OF MEASUREMENT AND PAYMENT

A. Measurement and Payment for the bid items listed in Base Bid shall be based on the description in the Technical Specifications and Drawings. Unless the work to be done is so specifically called out to be measured and paid for in Base Form, payment for such work shall be included in other applicable items, and there shall be no separate measurement and payment for the work.

B. Items listed in EJCDC Document C-410 – Bid Form as lump sum (L.S.) shall include all work for the complete installation as generally described in the Drawings and the Technical Specifications.

C. Payment shall be made at the contract bid price listed in the Bid Form.

D. Partial payment for unit price bid items and lump sum bid items only partially completed at the end of monthly pay periods shall be made based upon the Engineers interpretation of the percentage of work completed. Partial payment for materials delivered and stored will be considered, if said materials have been submitted to the Engineer for review per Section 01 33 00 – Submittal Procedures and supporting invoices and documentation have been provided.

E. Quantities indicated in the Bid Form are for bidding and contract purposes only, unless specified otherwise in the Technical Specifications.

F. If the actual work requires more or fewer quantities than those quantities indicated in the Bid Form, the Contractor shall provide the required quantities.

G. Payment Includes: Full compensation for all required labor, products, tools, equipment, materials, transportation, services and incidentals, erection, application, or installation of an item of the Work, including mobilization, demobilization, supervision, overhead and profit.

H. Final payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities accepted by the Engineer multiplied by the unit price for work which is incorporated in or made necessary by the Work unless specified otherwise.

1.7 ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in Owner-Contractor Agreement

B. Coordinate related work and modify surrounding work.

SCHEDULE OF BID ITEMS – BASE BID

GENERAL

1.8 MOBILIZATION – BID ITEM #1

A. Measurement shall be lump sum for the job, complete. Payment shall be as outline below:

PAY FACTORS FOR MOBILIZATION AND TEMPORARY FACILITIES	
Percent of Original Contract Amount Earned Not Including Materials Purchased	Percent of Amount Bid for Mobilization to be Paid
5	40
15	20
40	30
50	10

B. This includes, but not limited to, all labor and equipment and materials for, safely moving equipment and related materials to and from the site, sanitation facilities, power, required permitting, dust abatement, temporary utilities and controls, temporary fencing, traffic control, SWPPP if required, coordination of work with SCADA contractor, project related documentation and coordination with State and Local authorities. Payment for the performance of the mobilization work as specified herein will be made at the contract lump sum price for "Mobilization" as listed in the Bid Schedule.

C. Payment shall be made at the contract lump sum (LS) price stated in the Bid Form.

1.9 STARTUP AND COMMISSIONING – BID ITEM #2

A. No direct measurement will be made for this item. This item includes all equipment, labor, materials, and operation and maintenance manuals to test, calibrate, troubleshoot, and adjust the project equipment so that it is fully operational as described in the project specifications and drawings. Also included are the O&M manuals and other paperwork required for a Division of Drinking Water operating permit approval. Startup shall also include on-site training on the use of the pumps, motors, valves, flow meters, generator, automatic transfer switch, heating and cooling equipment and other equipment. Troubleshooting time shall not run concurrently with the demonstration and instruction. The onsite demonstration and instruction time shall not be considered to commence until the equipment is fully operational and performs as specified.

B. Payment shall be made at the contract lump sum price stated in the Bid Form.

SITE CIVIL

1.10 UNTREATED BASE COURSE (TYPE A4) – BID ITEM #3

A. Measurement for this item shall be per cubic yard. This item shall include all equipment, labor, and materials to place and compact material for the proposed access road along with patch repair for the waterline connection to the existing system shown on the plans. Base course used for locations other than under pavement will be paid for under a separate item.

B. Payment shall be made at the contract cubic yard price stated in the Bid Form.

1.11 12" DI WATERLINE– BID ITEM #4

A. Measurement for this item shall be per lineal foot. Measurement shall be measured beginning 5 ft from the exterior of a structure or to the connection sleeve whichever is greater and continue to the termination point for each respective waterline as shown on the drawings. Included in this item is all labor, equipment, and materials required for the installation of the pipe and connections including existing connections. This includes, but is not limited to, concrete encasement of pipe under concrete pad, all excavation, pipe, gaskets, restrained joints, fittings, valves, valve boxes, valve collars, magnetic locator tape, concrete encasement, trace wire, thrust blocking, placing and compacting of native backfill material, disposal (if necessary) of unsuitable backfill material, cleaning, compaction testing, pressure testing, chlorination and bacteriological testing of pipe, imported bedding and foundation material and related appurtenances and connections as shown on the drawings and described in the specifications and contract documents.

B. Payment shall be made at the contract unit price stated in the Bid Form. No payment will be made for use of native backfill materials.

1.12 8" PVC & DI PUMP TO WASTE DRAIN LINE – BID ITEM #5

A. Measurement for this item shall be per lineal foot. Measurement shall be measured beginning 5 ft from the exterior of a structure or to the connection sleeve whichever is greater and continue to the termination point for each respective waterline as shown on the drawings. Included in this item is all labor, equipment, and materials required for the installation of the pipe and connections including existing connections. This includes, but is not limited to, all excavation, pipe, gaskets, restrained joints, fittings, valves, valve boxes, valve collars, magnetic locator tape, trace wire, thrust blocking, placing and compacting of native backfill material, disposal (if necessary) of unsuitable backfill material, cleaning, concrete encasement, compaction testing, pressure testing, chlorination and bacteriological testing of pipe, imported bedding and foundation material and related appurtenances and connections as shown on the drawings and described in the specifications and contract documents.

B. Payment shall be made at the contract unit price stated in the Bid Form.

1.13 4" PVC BUILDING DRAIN LINE – BID ITEM #6

A. Measurement for this item shall be per lineal foot. Measurement shall be measured beginning 5 ft from the exterior of a structure or to the connection sleeve whichever is greater and continue to the termination point for the respective pipeline as shown on the drawings. Included in this item is all labor, equipment, and materials required for the installation of the pipe and connections including existing connections. This includes, but is not limited to, all excavation, pipe, gaskets, restrained joints, fittings, elbows, cleanouts, cleanout plugs,valves, valve boxes, termination treatment including rip rap and fabric, magnetic locator tape, trace wire, thrust blocking, placing and compacting of native backfill material, disposal (if necessary) of unsuitable backfill material, cleaning, concrete encasement, compaction testing, imported bedding and foundation material and related appurtenances and connections as shown on the drawings and described in the specifications and contract documents.

B. Payment shall be made at the contract unit price stated in the Bid Form.

1.14 CONCRETE SIDEWALK AND GENERATOR PAD – BID ITEM #7

A. Measurement for this item shall be based on the square foot area of concrete sidewalk and generator pad outside the building. This item includes all equipment, materials, labor, and costs of work required to construct the item. This item includes but not limited to, all earthwork, formwork, concrete, excavation, backfill, free draining material, compaction, finishing, reinforcement, and other related appurtenances. Contractor to verify and construct generator pad according to the manufacturer's requirements. No additional payment will be made for a thicker pad or reinforcement required by the manufacturer.

B. Payment shall be made at the square foot price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location, outside the pay limits.

1.15 WELL HOUSE RETAINING WALL – BID ITEM #8

A. Measurement for this item shall be based on the lineal foot length of retaining wall installed. This item includes all equipment, materials, labor, and costs of work required to construct the item. This item includes but not limited to, all earthwork, formwork, concrete, excavation, backfill, free draining material, compaction, finishing, footings, reinforcement, and other related appurtenances.

B. Payment shall be made at the lineal foot price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location, outside the pay limits.

1.16 FINAL SITE GRADING AND RESTORATION – BID ITEM #9

A. No direct measurement will be made for this item. This item shall include all equipment, labor, and materials to handle all earthwork and site grading of native or imported

materials to establish the finish grade shown on the Drawings. This includes all items required to establish the finished grade for the site, and any other items not specifically included in other bid items to complete the project as shown on the drawings and described in the specifications and contract documents.

B. Payment shall be made at the contract lump sum (LS) price stated in the Bid Form.

WELL BUILDING

1.17 BUILDING CONCRETE & REINFORCING – BID ITEM #10

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to construct the item. This item includes all earthwork, formwork, and other related items required to place and properly cure the building concrete with embedded reinforcing. All concrete and reinforcing required for the building, the enclosure wall, and the concrete slabs within the building and enclosure wall, foundation and slab gravel, testing, and compaction are included in this item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.18 STRUCTURAL MASONRY & REINFORCING – BID ITEM #11

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to construct the item. This item includes all structural masonry (CMU), reinforcing, mortar, grout, anchors, metal flashing, accessories, and other items embedded in the masonry.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.19 BUILDING METAL FABRICATIONS – BID ITEM #12

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to construct the item. All structural steel, wall sleeves, cover plates, vents, and miscellaneous fabrications from any metal used in any application for the construction of the building is included in this item. This item also includes all painting, galvanizing, coating, or other finishing of said fabrications. Roof hatches shall be paid for under separate items.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.20 ROUGH CARPENTRY – BID ITEM #13

A. No direct measurement will be made for this item. This item includes, but is not limited to, all equipment, materials, labor, and costs of work required to construct the item. All woodwork not visible in the finished building is included in this item. All blocking between trusses, truss braces, gable end braces, outlookers, and other wood elements attached to the trusses are included in this item. Also included in this item are all fasteners, structural connectors, strapping, and accessories required to construct this item. Prefabricated trusses shall be paid for under a separate item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.21 PREFABRICATED TRUSS PACKAGE – BID ITEM #14

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to design, transport, and install the item per the Contract Documents. Additional wood braces, blocking, outlookers, etc. attached to the prefabricated trusses shall be paid for under a separate item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.22 THERMAL AND MOISTURE PROTECTION – BID ITEM #15

A. No direct measurement will be made for this item. All waterproofing, water repellants, vapor retarders, joint sealants, weather barriers, and expansion joints are included in this item. Rigid, Batt, or Blown-in insulation shall be paid for under separate items. This item also includes all equipment, materials, labor, and costs of work required to construct the item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.23 RIGID INSULATION – BID ITEM #16

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to install the item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.24 BATT/BLOWN-IN INSULATION – BID ITEM #17

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to install the item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.25 ROOFING – BID ITEM #18

A. No direct measurement will be made for this item. All metal roofing, flashing, metal trim, rain gutters, downspouts, paint, and ridge vent are included in this item. This item includes all equipment, materials, labor, and costs of work required to construct the item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.26 BUILDING ROOF ACCESS HATCHES – BID ITEM #19

A. Measurement for this item shall be based on each item installed. This item includes, but is not limited to, all equipment, materials, labor, and costs of work required to obtain, transport, and construct the item. All additional metal trim, sealant, hardware, paint, coatings, anchors, reinforcing, and accessories required to install the item are included in this item.

B. Payment shall be made at the each price stated in the Bid Form.

1.27 WINDOWS, FRAMES, & HARDWARE – BID ITEM #20

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to construct the item. All glass, acrylic, polycarbonate, frames, metal trim, films, screens, sealant, hardware, paint, coatings, anchors, and accessories required to install the windows and frames are included in this item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.28 DOORS, FRAMES, & HARDWARE – BID ITEM #21

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to construct the item. All additional metal trim, sealant, hardware, paint, coatings, anchors, reinforcing, and accessories required to install the doors and frames are included in this item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.29 FRP PANELING – BID ITEM #22

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to construct the item. Any edge trim, fastening systems, anchors, and accessories required for installation are included in this item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.30 PLUMBING – BID ITEM #23

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to construct the item. This includes, but is not limited to, floor drains, p-traps, covers, piping, connections, fittings, and related appurtenances. Items which may be classified as mechanical piping shall be paid for under a separate item.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.31 HVAC – BID ITEM #24

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to construct the item. This shall include all heating equipment units, fans, louvers, ducting, vents, controls, and related accessories and appurtenances.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.32 WELL HOUSE PROCESS MECHANICAL PIPING – BID ITEM #25

A. No direct measurement will be made for the well house mechanical piping. This item shall include obtaining all required permits (fees paid by Owner) to construct the well house mechanical piping, all equipment, labor, and materials to furnish and construct the well house mechanical piping (including vertical and horizontal piping under the floor slab extending 5 feet from the building exterior) and fittings (interior of and beneath the building), pipe supports, air/vacuum valve and discharge piping, flow meter, valves, pressure gauges, tees, bends, fittings, ball valves, strainers and controls, spool pieces, gauges, taps, and all other items required as described in the Specifications and elsewhere in the Contract Documents. This shall also include labor, equipment and

materials needed to pressure test the below grade piping prior to placement of the floor slab. Payment for the ductile iron fittings connecting the horizontal portions of lines from beyond 5 feet of the exterior of the building shall be paid for under other items. The horizontal piping beginning at these fittings shall be paid for under a separate item. Items which may be considered as plumbing shall be paid for under a separate item.

B. Payment shall be made at the contract lump sum price stated in the Bid Form.

1.33 WELL PUMP AND MOTOR – BID ITEM #26

A. No direct measurement will be made for this item. This item shall include all equipment, labor, tools, and materials to furnish and install the deep well vertical turbine pump. This item also includes the column pipe with couplers, discharge head, base plate, and all other items required for a complete installation and operation of the well pump and motor as described in the Specifications and elsewhere in the Contract Documents. This item shall also include the factory non-witness performance test. Inspection and demonstration of operation and maintenance of the pump, motor and pressure transducer by factory-trained representative.

B. Payment shall be made at the lump sum price stated in the Bid Form. No payment shall be made for material nor labor used in an unauthorized location or outside the pay limits.

1.34 WELL PRE-LUBE SYSTEM – BID ITEM #27

A. No direct measurement will be made for this item. This item shall include all equipment, labor, tools, and materials to furnish and install the pre-Lube system. This item also includes but not limited to all connections, taps, valves, piping, pipe supports, bends, hydropneumatic pressure tank, gauges, switches, pump, pump support, and all other items required for a complete installation and operation of the system described and shown in the Drawings, Specifications and elsewhere in the Contract Documents.

B. Payment shall be made at the lump sum price stated in the Bid Form.

1.35 CHLORINATION SYSTEM – BID ITEM #28

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required for the construction of any item pertaining to the chlorination systems at the well house. This includes but is not limited to scales, regulators, sensors, detection equipment, vents, tubing, fittings, piping, injectors, valves, pumps, piping and pump supports, ejectors, screens, pipe connections, controls, motor, starter as needed, coordination with SCADA on connections to equipment, chlorine leak indicator bottle, gas mask and enclosure, chlorine drop test kit, and other related appurtenances.

B. Payment shall be made at the lump sum price stated in the Bid Form.

1.36 STANDBY GENERATOR – BID ITEM #29

A. No direct measurement will be made for this item. This item includes, but is not limited to, generator, transport, installation, wiring, testing, associated freight costs, automatic transfer switch, full tank of fuel, startup services, O&M manuals and all related items that are required to make the generator and automatic transfer switch fully operational as described in the Specifications, Drawings, and elsewhere in the Contract Documents.

B. Payment shall be made at the contract lump sum price stated in the Bid Form.

1.37 ELECTRICAL SERVICE– BID ITEM #30

A. No direct measurement will be made for this item. This item shall include all equipment, labor, and materials to furnish and install: electrical service, trenching and conduit installation from the electrical utility's existing ground sleeve, or drop, to well house conductor wire, pipe bedding, boring, elbows and sweeps, electrical conduit junction boxes.

B. Payment shall be made at the contract lump sum price stated in the Bid Form.

1.38 BUILDING ELECTRICAL – BID ITEM #31

A. No direct measurement will be made for this item. This item includes all equipment, materials, labor, and costs of work required to construct the item. All interior and exterior lighting, outlets, fans, switches, panels, sensors, controls, wiring, mixer, conduits, labels, instrumentation, I/O, communication, coordination and power to SCADA systems, start up, testing, control panel boards, motor control center, motor starter, VFDs, pressure switches, pressure transducer, disconnects, circuits, equipment enclosures, sensing, monitoring and controlling of equipment, thermostats, and related components not covered under another bid item that are necessary for a complete job as shown in the Drawings and as described in the Specifications and elsewhere in the Contract Documents. The electrical power service and generator shall be paid for under separate items.

B. CONTRACTOR shall install, wire and terminate the PLC panel, and provide assistance performing I/O checks. Instrumentation by CONTRACTOR.

C. Payment shall be made at the lump sum price stated in the Bid Form.

1.39 SCADA (SKM SUBCONTRACTOR) – BID ITEM #32

A. No direct measurement will be made for this item. All work provided by this item and SKM shall be subcontracted through contractor. This item shall include all equipment, materials, labor, and costs of work provided by SKM to do the SCADA work.

B. Any equipment, materials, labor, and costs of work not included by SKM, shall be covered under the separate Bid Item #31 - Building Electrical.

C. Payment shall be made at the lump sum price stated in the Bid Form.

D. Contractor to obtain bid item price from SKM contact provided in plans.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01 26 63
CHANGE ORDERS

PART 1 GENERAL

This section is supplemental to C-700—General Conditions. If discrepancies exist, the more stringent shall apply.

1.1 SECTION INCLUDES

A. Submittals.

B. Documentation of change in Contract Price and Contract Time.

C. Change procedures.

D. Construction Change Authorization.

E. Stipulated Price Change Order.

F. Unit price change order.

G. Time and material change order.

H. Execution of change orders.

I. Correlation of Contractor submittals.

1.2 RELATED SECTIONS

A. EJCDC C-520 – Agreement.

B. EJCDC C-700 – General Conditions.

C. EJCDC C-800 – Supplementary Conditions.

D. Section 01 22 00 – Measurement and Payment.

E. Section 01 33 00 – Submittal Procedures.

F. Section 01 60 00 – Product Requirements.

G. Section 01 77 00 – Closeout Procedures.

1.3 SUBMITTALS

A. Submit name of the individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.

B. Change Order Forms: EJCDC C-941 – Change Order.

1.4 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

A. Maintain detailed records of work done on a time and material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs of changes in the Work.

B. Document each quotation for a change in cost or time with sufficient data to allow evaluation of the quotation.

C. On request, provide additional data to support computations:
1. Quantities of products, labor, and equipment.
2. Taxes, insurance and bonds.
3. Overhead and profit.
4. Justification for any change in Contract Time.
5. Credit for deletions from Contract, similarly documented.

D. Support each claim for additional costs, and for work done on a time and material basis, with additional information:
1. Origin and date of claim.
2. Dates and times work was performed, and by whom.
3. Time records and wage rates paid.
4. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

1.5 CHANGE PROCEDURS

A. The Engineer will advise of minor changes in the Work not involving an adjustment to Contract Price or Contract Time, as authorized by Article II of the General Conditions by issuing supplemental instructions.

B. The Engineer may issue a Notice of Change which includes a detailed description of a proposed change with supplementary or revised Drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor will prepare and submit an estimate within five (5) days.

C. The Contractor may propose a change by submitting a request for change to the Engineer, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Price and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01 60 00.

1.6 CONSTRUCTION CHANGE AUTHORIZATION

A. Engineer may issue a document, signed by the Owner, instructing the Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

B. The document will describe changes in the Work, and will designate method of determining any change in Contract Price or Contract Time.

C. Promptly execute the change in Work.

1.7 STIPULATED PRICE CHANGE ORDER

A. Based on Notice of Change and Contractor's fixed price quotation or Contractor's request for a Change Order as approved by OWNER.

1.8 UNIT PRICE CHANGE ORDER

A. For pre-determined unit prices and estimated quantities, the Change Order will be executed on a fixed unit price basis.

B. For unit costs or quantities of units of work, which are not pre-determined, execute Work under a Change Order.

C. Changes in Contract Price or Contract Time will be computed as specified for Time and Material Change Order.

1.9 TIME AND MATERIAL CHANGE ORDER

A. Submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.

B. Engineer will recommend to the OWNER the change allowable in Contract Price and Contract Time as provided in the Contract Documents.

C. Maintain detailed records of work done on Time and Material basis.

D. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

1.10 EXECUTION OF CHANGE ORDERS

A. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.11 CORRELATION OF CONTRACTOR SUBMITTALS

A. Promptly revise Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.

B. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust time for other items of work affected by the change, and resubmit.

C. Promptly enter changes in Project Record Documents.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination.

B. Field Engineering.

C. Preconstruction Conference.

D. Progress Meetings.

1.2 COORDINATION

A. Coordinate scheduling, submittals, and Work of the various sections of specifications to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Coordinate space requirements, supports, and installation of mechanical and electrical Work, which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable. Utilize spaces efficiently to maximum accessibility for other installations, for maintenance, and for repairs.

C. Coordinate completion and cleanup of Work of separate sections in preparation for Substantial Completion.

D. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having independent responsibilities for installing, connecting to, and placing in service, such equipment.

E. After Owner’s assumption of the completed project, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 FIELD ENGINEERING

A. The Contractor shall locate and protect survey control and reference points. Replacement of survey control and reference points will be at the Contractor’s expense.

B. Control datum for survey is that established by Owner provided survey.

C. Verify setbacks and easements. Confirm drawing Dimensions and elevations.

1.4 PRECONSTRUCTION CONFERENCE

A. Owner and Engineer will schedule a conference after Notice of Award.

B. Attendance Required: Owner or their representative, Engineer, Contractor, and Major Subcontractors.

C. Agenda:
1. Execution of Owner-Contractor Agreement
2. Submission of executed bonds and insurance certificates.
3. Distribution of Contract Documents.
4. Submission of list of Subcontractors, list of products, Schedule of Values, and progress schedule.
5. Designation of personnel representing the parties in Contract, and the Engineer.
6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
7. Scheduling.
8. Surveying, layout and scheduling.
9. Site visit as necessary.

1.5 PROGRESS MEETINGS

A. The Engineer will schedule and administer meetings as needed by Owner and Contractor throughout progress of the Work.

B. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, and Engineer, as appropriate to agenda topics for each meeting.

C. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that are impeding or may impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Review Cleanup and restrictions
13. Effect of proposed changes on progress schedule and coordination.
14. Other business relating to Work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Submittal procedures.

B. Construction progress schedules.

C. Proposed products list.

D. Shop drawings.

E. Product data.

F. Samples.

G. Manufacturers' instructions.

H. Manufacturers' certificates.

I. Spare parts and maintenance materials.

1.2 RELATED SECTIONS

A. Section 01 22 00 – Measurement and Payment

B. Section 01 40 00 – Quality Requirements

C. Section 01 70 00 – Execution and Closeout Requirements

1.3 SUBMITTAL PROCEDURES

A. Transmit each submittal with a letter of transmittal or Engineer accepted form containing all pertinent information required for identification and checking of submittals.

B. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.

C. Identify Project, Contractor, Subcontractor or supplier, pertinent Drawing sheet and detail name or number(s), and specification Section number, as appropriate.

D. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract

Documents. Submittals without the Contractor's stamp will not be reviewed and will be returned to the Contractor.

E. Schedule submittals to expedite the Project, and deliver to Engineer at business address. Electronic submittals in PDF format are preferred. Coordinate and group submission of related items.

F. Identify all variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.

G. Provide space for Contractor and Engineer review stamps.

H. Revise and resubmit submittals as required. Identify all changes made since previous submittal.

I. When specified in the specification section, the Contractor shall submit a copy of the technical specification with each subsection clearly marked for conformance to the subsection or exceptions taken. Where exceptions are taken, all necessary information and supporting calculations to evaluate the deviation shall be attached. The Owner retains the right to reject the proposed deviation in favor of the specification, as written.

J. The Contractor shall be responsible for submitting complete and accurate information in accordance with the Contract Documents. Contractor shall review all subcontractor provided submittals before submitting to the Engineer or Owner. For submittals requiring more than three reviews due to incompleteness or inaccuracy of initial submissions, Owner and/or Engineer may assess fees for the time and labor required to review additional submissions.

K. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.4 CONSTRUCTION PROGRESS SCHEDULES

A. Submit initial progress schedule in duplicate within 15 days after date established in Notice to Proceed for Engineer review. Submit progress schedule no later than Preconstruction Conference.

B. Revise and resubmit as required.

C. Submit revised schedules with each Application for Payment, identifying changes since previous version.

D. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.

E. Indicate estimated percentage of completion for each item of Work at each submission.

F. Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates.

1.5 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, compile and submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

C. Apply Contractor's stamp, signed or initialed certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and Contract Documents.

1.6 SHOP DRAWINGS

A. Shop drawings are required for all mechanical and structural installations. These drawings shall show adequate dimensions to review submittals for fit.

B. Submit all Shop drawings in electronic format as approved by Engineer.

C. When required by individual specification sections or as noted on the Drawings, provide shop drawings signed and sealed by professional engineer responsible for designing components shown on shop drawings.
   1. Include signed and sealed calculations to support design.
   2. Submit drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
   3. Make revisions and provide additional information when required by authorities having jurisdiction.

D. After review distribute in accordance with Article on Procedures above and for Record Documents described in Section 01 77 00 - Closeout Procedures and in Document C-700 General Conditions.

1.7 PRODUCT DATA

A. Submit all product data in electronic format as approved by Engineer.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.

C. After review, distribute in accordance with Article on Procedures above and provide copies for Record Documents described in Section 01 77 00 - Closeout Procedures and in Document C-700 General Conditions.

D. Indicate product characteristics that vary from these Specifications.

1.8 SAMPLES

A. Submit samples in accordance with the following requirements when requested in individual sections or as requested by the Engineer.

B. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

C. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Owner's selection.

D. Include identification on each sample, with full Project information.

E. Submit the number or samples specified in individual specification Sections; one of which will be retained by Engineer.

F. Reviewed samples which may be used in the Work are indicated in individual specification Sections.

G. Samples will not be used for testing purposes unless specifically stated in specification section.

1.9 MANUFACTURERS' INSTRUCTIONS

A. When specified in individual specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. Identify conflicts between manufacturers' instructions and Contract Documents.

1.10 MANUFACTURERS' CERTIFICATES

A. When specified in individual specification Sections, submit manufacturers' certificate to Engineer for review, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.11 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

B. Deliver to project site; obtain receipt prior to final payment.

1.12 CONSTRUCTION PHOTOGRAPHS AND VIDEO

A. Provide photographs and/or video of site and construction throughout progress of Work as required by Engineer. Photographs and video shall show key components of Work, significant milestones, and installation processes pertinent to the Project.

B. Submit photographs and video for progress period with each Application for Payment.

C. Submit all photographs and video in electronic format as approved by Engineer.

D. Deliver photographs and video in electronic format to Owner with project record documents. Catalog and index photographs and video in chronological sequence; include typed table of contents.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01 42 19
REFERENCE STANDARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality assurance.

B. Schedule of references.

1.2 RELATED SECTIONS

A. EJCDC C-700 – General Conditions

1.3 QUALITY ASSURANCE

A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents.

C. Maintain copy at job site during submittals, planning, and progress of the specific work, until Substantial Completion.

D. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

E. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.4 SCHEDULE OF REFERENCES

AA Aluminum Association
818 Connecticut Avenue, N.W.
Washington, DC 20006

AASHTO American Association of State Highway and Transportation Officials
444 North Capitol Street, N.W.
Washington, DC 20001

ACI American Concrete Institute
3880 Country Club Drive
Farmington Hills, MI 48331

AGC Associated General Contractors of America
1957 E Street, N.W.
Washington, DC 20006

AI Asphalt Institute
Asphalt Institute Building
College Park, MD 20740

AIA American Institute of Architects
1735 New York Avenue, N.W.
Washington, DC 20006

AISC American Institute of Steel Construction
400 North Michigan Avenue, Eighth Floor
Chicago, IL 60611

AISI American Iron and Steel Institute
1000 16th Street, N.W.
Washington, DC 20036

ANSI American National Standards Institute
1430 Broadway
New York, NY 10018

ASME American Society of Mechanical Engineers
345 East 47th Street
New York, NY 10017

ASPA American Sod Producers Association
4415 West Harrison Street
Hillside, IL 60162

ASTM American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103

AWI Architectural Woodwork Institute
2310 South Walter Reed Drive
Arlington, VA 22206

AWS American Welding Society
550 LeJeune Road, N.W.
Miami, FL 33135

AWWA American Water Works Association
6666 West Quincy Avenue
Denver, CO 80235

CDA Copper Development Association
57th Floor, Chrysler Building
405 Lexington Avenue
New York, NY 10174

CRSI Concrete Reinforcing Steel Institute
933 Plum Grove Road
Schaumburg, IL 60195

EJCDC Engineers' Joint Contract Documents Committee
American Consulting Engineers Council
1015 15th Street, N.W.
Washington, DC 20005

EJMA Expansion Joint Manufacturers Association
25 North Broadway
Tarrytown, NY 10591

FS Federal Specification
General Services Administration
Specifications and Consumer Information

Distribution Section (WFSIS)
Washington Navy Yard, Bldg. 197
Washington, DC 20407

ICBO International Conference of Building Officials
5360 S. Workman Mill Road
Whittier, CA 90601

IEEE Institute of Electrical and Electronics Engineers
345 East 47th Street
New York, NY 10017

ML/SFA Metal Lath/Steel Framing Association
221 North LaSalle Street
Chicago, IL 60601

NAAMM National Association of Architectural Metal Manufacturers
221 North LaSalle Street
Chicago, IL 60601

NCMA National Concrete Masonry Association
P.O. Box 781
Herndon, VA 22070

NEMA National Electrical Manufacturers' Association
2101 'L' Street, N.W.
Washington, DC 20037

NFPA National Fire Protection Association
Battery March Park
Quincy, MA 02269

NSWMA National Solid Wastes Management Association
1730 Rhode Island Ave., N.W.
Washington, DC 20036

PCA Portland Cement Association
5420 Old Orchard Road
Skokie, IL 60077

PCI Prestressed Concrete Institute
201 North Wells Street
Chicago, IL 60606

PS Product Standard
U. S. Department of Commerce
Washington, DC 20203

SSPC Steel Structures Painting Council
4400 Fifth Avenue
Pittsburgh, PA 15213

UDEQ Utah Department of Environmental Quality
Division of Drinking Water
150 North 1950 West
Salt Lake City, Utah 84116

UDFCM Utah Department of Facilities Construction and Management
4110 State Office Building
Salt Lake City, Utah 84114

UDSH Utah Division of State History
300 Rio Grande
Salt Lake City, Utah 84114

UL Underwriters' Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062

USPR Utah State Parks and Recreation
P.O. Box 146001
Salt Lake City, Utah 84114-6001

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 45 00
QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality assurance and control of installation.

B. Tolerances.

C. References.

D. Field samples.

E. Labeling.

F. Construction observation and testing laboratory services.

G. Manufacturers' field services and reports.

1.2 RELATED SECTIONS

A. Section 01 42 19 – Reference Standards

B. Section 01 33 00 – Submittal Procedure

C. Section 01 60 00 – Product Requirements

1.3 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers' instructions, including each step in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce workmanship of specified quality.

F. Verify field measurements are as indicated on the Shop Drawings or as instructed by manufacturer.

G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.4 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.5 REFERENCES

A. Conform to reference standard by date of issue current on date of Contract Documents.

B. Should specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

C. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.6 FIELD SAMPLES

A. Install field samples at the site as required by individual specifications Sections for review.

B. Acceptable samples represent a quality level for the Work.

C. Where field sample is specified in individual Sections to be removed, clear area after field sample has been accepted by Engineer.

1.7 LABELING

A. Attach label to products, assemblies, and systems required to be labeled by applicable codes, and as required by Engineer.

B. Label Information: Include manufacturer's or fabricator's identification and contact information, approved agency identification, and the following information, as applicable, on each label.
   1. Model number.
   2. Serial number.
   3. Performance characteristics.
   4. Other information as stated on the Drawings and in the Contract Documents.

1.8 CONSTRUCTION OBSERVATION AND TESTING LABORATORY SERVICES

A. The Owner and Engineer shall provide observation during construction.

B. The Owner's Representative will oversee observation of all tests run in the field.

C. The Contractor shall pay for the services of an independent tester and testing laboratory where specified in individual specification sections. This shall include but not limited to aggregate compaction testing, and concrete testing.

D. The contractor shall be responsible to complete pressure tests, bacteriological tests including lab fees, chemical analysis including lab fees, and other tests as required that are not specifically listed in C above.

E. The Contractor shall provide adequate access to site, materials, and other means for the independent tester.

F. The Contractor shall be responsible for providing the equipment and manpower to assist the representative in taking tests.

G. Reports will be submitted by independent firm to the Engineer, in electronic format, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

H. Cooperate with the Engineer; furnish samples of materials, mix designs, equipment, tools, storage and assistance as requested.
   1. Notify the Engineer and independent firm 48 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

I. Retesting required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Representative. Costs for retesting shall be borne by the Contractor.

1.9 MANUFACTURERS' FIELD SERVICES AND REPORTS

A. When specified in individual specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment, as applicable, and to initiate instructions when necessary.

B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit report electronically within 15 days of observation to Engineer for review.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Temporary Utilities:
   1. Temporary Water Service
   2. Temporary Sanitary Facilities
   3. Temporary Electricity
   4. Temporary Ventilation

B. Temporary Controls:
   1. Barriers
   2. Water Control
   3. Dust Control
   4. Erosion and Sediment Control
   5. Pollution Control
   6. Security
   7. Pest Control
   8. Noise Control
   9. Tree and Plant Protection
   10. Protection of Existing Improvements
   11. Protection of Installed Work
   12. Traffic Regulation
   13. Fire Prevention Facilities
   14. Progress Cleaning

C. Construction Facilities:
   1. Access Roads
   2. Parking

D. Removal of Utilities, Facilities, and Controls

E. Construction Documentation:
   1. Permits
   2. Storm Water Pollution Prevention Plan (SWPPP)

1.2 RELATED SECTIONS

A. Section 01 70 00 – Execution and Closeout Requirements

1.3 TEMPORARY UTILITIES

A. TEMPORARY WATER SERVICE
   1. Provide, maintain, and pay for suitable quality water required for construction operations.

B. TEMPORARY SANITARY FACILITIES
   1. Provide, maintain, and pay for required facilities and enclosures, and services required for construction operations.

C. TEMPORARY ELECTRICITY
   1. Provide, maintain, and pay for temporary power required for construction operations.

D. TEMPORARY VENTILATION
   1. Provide, maintain, and pay for temporary ventilation equipment as required for construction operations.

1.4 TEMPORARY CONTROLS

A. BARRIERS
   1. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of site, to protect public safety, and to protect existing facilities and adjacent properties from damage from construction operations.
   2. Provide protection for plant life designated to remain. Replace damaged plant life.
   3. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

B. WATER CONTROL
   1. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment as needed.
   2. Protect site from ponding or running water. Provide water barriers as required to protect site from soil erosion.

C. DUST CONTROL
   1. Execute work by methods to minimize raising dust from construction operations.
   2. Provide positive means to prevent air-borne dust from dispersing into atmosphere.
   3. Furnish and apply POTABLE water required in construction and for dust control, in accordance with the requirements of these specifications.
   4. Water, when required, shall be applied at the locations and in the amounts required to properly compact the work. The equipment used for watering shall be of ample capacity and of such design as to assure uniform application of water in the amounts required.

5. If required, watering shall be done at night or at other times when evaporation loss will be at a minimum.
6. In watering of subgrades, the Engineer may direct the Contractor to apply water in such quantities that the subgrade shall be compacted at a moisture content in excess of "optimum moisture." In no case will the Contractor be required to apply water in excess of three percent (3%) of optimum moisture.
7. The Contractor shall also apply water during the course of the work to control dust, maintaining all embankment and base courses in a damp condition.
8. The Contractor shall provide sufficient equipment to apply water as directed for controlling dust caused by construction activities. If dusty conditions continue to exist due to insufficient or inadequate watering practices or lack of watering equipment, it shall cause the closing down of those operations affected until remedied. Watering shall be done on Saturdays, Sundays, and Holidays at the same frequency and amounts as specified for work days at the Contractor's expense.
9. Watering equipment shall consist of water-tight tanks mounted on trucks, adequately powered, and capable of applying water as required. The water shall be applied under pressure from the tank through a spray apparatus as directed. The spray apparatus shall be equipped as to provide uniform, unbroken spread of water over the surface being watered. A suitable device for positive shut-off and for regulating the flow of water shall be located so as to permit positive drive control from the cab.

D. EROSION AND SEDIMENT CONTROL
1. Plan, submit, and obtain a SWPPP permit if required, and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
2. Minimize amount of bare soil exposed at one time.
3. Provide temporary measures such as berms, dikes, drains, and other devices to prevent water flow and erosion.
4. Construct fill and waste areas by selective placement to avoid erosion of surface silts or clays.
5. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

E. POLLUTION CONTROL
1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
2. Equipment and fuel storage shall be kept secured. Waste oil and waste fluids shall not be stored or changed at any construction site.

F. SECURITY
1. Provide security and facilities to protect Work from unauthorized entry, vandalism or theft.

G. PEST CONTROL

1. Provide methods, means, and facilities to prevent pests, rodents, insects, or other animals from damaging the Work, entering any facility, or accessing or invading the premises.

H. NOISE CONTROL

1. Construction involving noisy operations, including starting and warming up of equipment, shall be restricted to the hours between 7:00 a.m. and 7:00 p.m. on weekdays. Noisy operations shall be scheduled to minimize their duration and to ensure their completion by 7:00 p.m.
2. Notification of special circumstances or emergency conditions that require work beyond the hours specified above shall be provided as follows:
    a. The Contractor shall notify the Engineer 48 hours in advance of any proposed extended work hours for preauthorization. Notification shall include a written request for authorization to perform work specified and the circumstances that warrant this request. This notification shall include any additional measures to mitigate noise generated by this construction activity if deemed necessary by the Engineer.
    b. If an emergency situation occurs that warrants extended hours, the Contractor shall notify the Engineer immediately upon determining the need for this work.

I. TREE AND PLANT PROTECTION

1. CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS: All landscaped areas and other surface improvements which are damaged by actions of the Contractor shall be restored to a condition equal to or better than it was prior to construction. Areas shall not be cleared until related construction activities require the work.

J. PROTECTION OF EXISTING IMPROVMENTS

1. Maintain construction activities within easements or limits of construction outlined on the plans.

K. PROTECTION OF INSTALLED WORK

1. Protect installed Work and provide special protection where specified in individual specification Sections.
2. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.

L. TRAFFIC REGULATION

1. Provide any signs, signals, lights, devices, or flagging personnel as required to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.
2. Relocate as Work progresses to maintain effective traffic control.

M. FIRE PREVENTION FACILITIES

1. Establish measures and provide equipment as necessary to prevent the starting and spreading of any fire on or near the Project site.
2. Provide areas for smoking, and performing hazardous operations capable of starting a fire, by clearing and removing any nearby brush and flammable materials. Maintain areas until the threat of fire does not exist.

N. PROGRESS CLEANING

1. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
2. Remove waste materials, debris, and rubbish from site periodically and dispose off-site in approved solid waste facilities at no additional cost to owner.
3. Provide necessary containment and clean-up of all hazardous/dangerous materials on-site that result from Contractor's actions.
4. Dispose of all hazardous/dangerous waste in approved hazardous waste facilities.

1.5 CONSTRUCTION FACILITIES

A. ACCESS ROADS

1. Construct and maintain temporary roads accessing public thoroughfares to serve construction area.
2. Construct temporary bridges and/or culverts to span low areas and allow unimpeded drainage.
3. Extend and relocate access roads as Work progress requires. Provide detours as necessary for impeded traffic flow in excess of two hours.
4. Provide and maintain access to fire hydrants, free of obstructions.
5. Provide and maintain access for emergency vehicles.
6. Provide means of removing mud from vehicle wheels before entering streets.

B. PARKING

1. Do not allow construction personnel to park in any way which may affect the access of emergency vehicles or city personnel.
2. Arrange for temporary surface parking to accommodate construction personnel.
3. When site space is not adequate, provide additional off-site parking.

1.6 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Substantial Completion.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.7 CONSTRUCTION DOCUMENTATION

A. PERMITS
   1. Pay for and obtain any building, encroachment, or other permits from the respective authorities as required.

B. STORM WATER POLLUTION PREVENTION PLAN (SWPPP)
   1. The Contractor shall provide and pay for a SWPPP for the site, if required. The Contractor shall also apply and pay for the Notice of Intent for the project.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Products.

B. Transportation and handling.

C. Storage and protection.

D. Product options.

E. Substitutions.

1.2 RELATED SECTIONS

A. EJCDC C-200 – Instructions to Bidders

B. Section 01 40 00 – Quality Requirements

1.3 PRODUCTS

A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for reuse.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

C. Provide interchangeable components of the same manufacturer, for similar components.

1.4 TRANSPORTATION AND HANDLING

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly review and inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged. Replace damaged products at no additional cost to OWNER.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.5 STORAGE AND PROTECTION

A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible.

B. Store sensitive products in weather-tight, climate-controlled enclosures.

C. For exterior storage of fabricated products, place on sloped supports above ground.

D. Provide off-site storage and protection when site does not permit on-site storage or protection.

E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.

F. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

H. Arrange storage of products to permit access for observation and documentation. Periodically inspect and review to assure products are undamaged and are maintained under specified conditions.

1.6 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed unless stated otherwise. Submit a request for substitution for any manufacturer not named.

1.7 SUBSTITUTIONS

A. Engineer will consider requests for Substitutions only within 30 days after date of Owner-Contractor Agreement.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that the Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the Substitution as for the specified product.

3. Has reviewed installation for fit with existing or new components or construction constraints.
4. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
5. Waives claims for additional costs or time extension which may subsequently become apparent.
6. Will reimburse Owner for review or redesign services associated with re-approval by Engineer and authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution Submittal Procedure:
1. Submit electronic copies to Engineer, as indicated in Section 01 33 00 – Submittal Procedures, of request for Substitution for consideration. Limit each request to one proposed Substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 75 16
STARTUP PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Starting systems.

B. Demonstration and instructions.

1.2 RELATED SECTIONS

A. EJCDC C-700 – General Conditions

B. Section 01 33 00 – Submittal Procedures

C. Section 01 45 00 – Quality Control

D. Section 01 60 00 – Product Requirements

1.3 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Owner and Engineer seven days prior to start-up of each item.

C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of responsible manufacturer's representative and in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report in accordance with Section 01 45 00 – Quality Control, that equipment or system has been properly installed and is functioning correctly.

1.4 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled times, at equipment location.

E. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout Procedures

B. Final Cleaning

C. Surface Restoration

D. Adjusting

E. Project Record Documents

F. Warranties and Bonds

G. Spare Parts and Maintenance Materials

1.2 RELATED SECTIONS

A. EJCDC C-700 – General Conditions

B. Section 01 50 00 – Temporary Facilities and Controls

1.3 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been reviewed, inspected, and documented, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.

B. Provide submittals to Engineer that are required by governing agencies or other authorities.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.4 FINAL CLEANING

A. Execute final cleaning prior to final review.

B. Clean equipment and fixtures to a sanitary condition.

C. Clean debris from Project area, including roofs and drainage systems.

D. Clean site; sweep paved areas, rake clean landscaped surfaces.

E. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.5 SURFACE RESTORATION:

A. Restore any damaged surface to a condition equal to or better than it was prior to construction.

B. Fill in depressions or ruts as required to restore ground surface to original condition.

1.6 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

B. Adjust all products to assure smooth and proper fit.

1.7 PROJECT RECORD DOCUMENTS

A. Maintain on site, one set of the following record documents; record actual revisions to the Work:
   1. Contract Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other Modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer’s instructions for assembly, installation and adjusting.

B. Store Record Documents separate from documents used for construction.

C. Ensure entries are complete and accurate, enabling future references by Owner.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and Modifications.

F. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   2. Measured locations of utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   3. Field changes of dimension and detail.
   4. Details not on original Contract Drawings.

G. Draw a line through the Engineer title block and seal on all documents submitted as Record Drawings. Make sure that each of these documents contains the names and dates of the people recording the record information.

H. Submit documents to Engineer with claim for final Application for Payment.

1.8 WARRANTIES AND BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Include Table of Contents and assemble in electronic (PDF) format.

F. Submit prior to final Application for Payment.

G. Time of Submittals:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
   2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.9 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance, and extra materials in quantities specified in individual specification Sections.

B. Deliver to Project site and place in location as directed by Owner.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality Assurance

B. Format

C. Contents

D. Manual for Equipment and Systems

E. Instruction of Owner's personnel.

F. Submittals.

1.2 RELATED SECTIONS

A. EJCDC C-700 – General Conditions

B. Section 01 33 00 – Submittal Procedures

C. Section 01 45 00 – Quality Control

D. Section 01 60 00 – Product Requirements

1.3 QUALITY ASSURANCE

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.4 FORMAT

A. Prepare data in the form of a reference manual.

B. Binders: Commercial quality, 8-1/2 x 11, three D side ring binders with durable plastic covers; 2-inch maximum ring size. When multiple binders are used, correlate data into related, consistent groupings.

C. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.

D. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.

E. Text: Manufacturer's printed data, or typewritten data on 20-pound paper.

F. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

G. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by components. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following where applicable:

    a. Significant design criteria.
    b. List of equipment.
    c. Parts list for each component.
    d. Operating instructions.
    e. Maintenance instructions for equipment and systems.
    f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:

    a. Shop drawings and product data.
    b. Certificates.
    c. Photocopies of warranties (and bonds).

1.5 CONTENTS, EACH VOLUME

A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Engineer, Subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.

C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 – Quality Control.

F. Warranties: Bind in copy of each.

G. Bonds: Bind in photocopy of each.

1.6 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications by label machine.

C. Include color coded wiring diagrams as installed.

D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions; cleaning and coating; etc.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

L. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

M. Provide as a minimum manufacturer’s operation and maintenance manual for:
1. Access Hatches
2. Safety equipment
3. Valves
4. Piping
5. Pipe Fittings
6. Gages
7. Chlorine equipment

8. Electrical equipment

1.7 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.8 SUBMITTALS

A. Submit two (2) copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit two (2) copies of complete volumes 15 days prior to final inspection. One copy will be reviewed and returned after final inspection, with Engineer comments. Revise content of all document sets as required prior to final submission.

D. Submit four (4) sets of revised final volumes in final form within 10 days after final inspection.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 03 01 00
MAINTENANCE OF CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES:

1. Concrete reinforcement repair.
2. Concrete surface repair.
3. Concrete crack repair.

1.2 MEASUREMENT AND PAYMENT

A. No separate measurement and payment will be made for surface repairs, crack repairs, or other defect repair required under this section. No separate or additional measurement and payment shall be made for wall and floor surface coating required under this section.

1.3 REFERENCES

A. ASTM International:

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
3. ASTM C33 - Standard Specification for Concrete Aggregates.
4. ASTM C109/C109M - Standard Test Method for Compressive strength of Hydraulic Cement Mortars (Using 2-in. or (50 mm) Cube Specimens).
5. ASTM C150 - Standard Specification for Portland Cement.
6. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
7. ASTM C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
8. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
9. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
10. ASTM C1042 - Standard Test Method for Bond Strength of Latex Systems Used With Concrete By Slant Shear.
11. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
12. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
13. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.

C. Manufacturer's Instructions: Submit mixing instructions.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 - Closeout Procedures.

B. Project Record Documents: Accurately record actual locations of structural repairs, type of repair, and products used.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

B. Applicator: Company specializing in concrete repair with minimum three years' experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Comply with instructions for storage, shelf life limitations, and handling.

PART 2 PRODUCTS

2.1 EPOXY ADHESIVE INJECTION MATERIALS

A. Manufacturers:
1. The Euclid Chemical Company.
2. L & M Construction Chemicals Inc.
3. Sika Corporation
4. Substitutions: Section 01 60 00 - Product Requirements.

B. Epoxy Adhesive: Two-part epoxy adhesive containing 100 percent solids, meeting the following minimum characteristics:

	Characteristic	Test Method	Results
1.	Bond Strength	ASTM C882	2,700 psi
2.	Tensile Strength	ASTM D638	6,600 psi
3.	Elongation	ASTM D638	2 percent at 7 days 70 degrees F
4.	Flexural Strength	ASTM D790	8,000 psi
5.	Compressive Strength	ASTM D695	6,500 psi

2.2 EPOXY MORTAR MATERIALS

A. Manufacturers:
   1. The Euclid Chemical Company.
   2. L & M Construction Chemicals Inc.
   3. Sika Corporation
   4. Substitutions: Section 01 60 00 - Product Requirements.

B. Epoxy Mortar: Three-part epoxy binding resin and aggregate mortar mixture.

C. Epoxy Binding Resin: Two-part epoxy resin containing 100 percent solids, meeting the following minimum characteristics:

	Characteristic	Test Method	Results
1.	Bond Strength	ASTM C882	2,700 psi
2.	Tensile Strength	ASTM D638	6,600 psi
3.	Elongation	ASTM D638	2 percent at 7 days 70 degrees F
4.	Flexural Strength	ASTM D790	8,000 psi
5.	Compressive Strength	ASTM D695	6,500 psi

D. Aggregate: Type recommended by mortar manufacturer.

2.3 CEMENTITIOUS MORTAR MATERIALS

A. Manufacturers:
   1. The Euclid Chemical Company.
   2. L & M Construction Chemicals Inc.
   3. Sika Corporation
   4. Substitutions: Section 01 60 00 - Product Requirements.

B. Cementitious Mortar: Packaged latex modified, silica fume enhanced, or portland cement patching mortar with the following properties:
   1. Compressive Strength: ASTM C109/C109M; minimum 2,000 psi after one day and 5,000 psi after 28 days.
   2. Bond Strength: ASTM C882 or ASTM C1042; minimum 2,500 psi after 28 days.
   3. Flexural Strength; ASTM C293; minimum 1,500 psi after 28 days.

C. Bonding Agent: Polyvinyl acetate emulsion, dispersed in water while mixing, non-coagulant in mix, water resistant when cured.

D. Cleaning Agent: Commercial muriatic acid.

2.4 MIXING EPOXY MORTAR

A. Mix epoxy mortars to consistency for purpose intended.

B. Mix components in clean equipment or containers. Conform to pot life and workability limits.

2.5 MIXING CEMENTITIOUS MORTAR

A. Mix cementitious mortar to consistency required for purpose intended.

B. Include bonding agent as additive to mix.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify surfaces are ready to receive work.

B. Beginning of installation means acceptance of substrate.

3.2 PREPARATION

A. Clean concrete surfaces of dirt, laitance, corrosion, or other contamination; wire brush using acid; rinse surface and allow to dry.

B. Flush out cracks and voids with chemical solvent or muriatic acid to remove laitance and dirt. Chemically neutralize by rinsing with water.

C. Sandblast clean exposed reinforcement steel surfaces.

D. Repair exposed structural, shrinkage, and settlement cracks of concrete by epoxy injection, epoxy application, bonding agent and cementitious paste method as appropriate or as directed by the Project Engineer.

E. Repair spalling. Fill voids flush with surface. Apply surface finish.

3.3 INJECTION - EPOXY RESIN

A. Provide temporary entry ports spaced to accomplish movement of fluids between ports; no deeper than depth of crack to be filled or port size diameter no greater than thickness of crack. Provide temporary seal at concrete surface to prevent leakage of adhesive.

B. Inject epoxy resin adhesive into prepared ports under pressure using equipment appropriate for particular application.

C. Begin injection at lower entry port and continue until adhesive appears in adjacent entry port. Continue from port to port until entire crack is filled.

D. Remove temporary seal and excess adhesive.

E. Clean surfaces adjacent to repair and blend finish.

3.4 APPLICATION - EPOXY MORTAR

A. Remove broken and soft concrete 1/4 inch deep. Remove corrosion from steel. Clean surfaces mechanically; wash with acid; rinse with water.

B. Trowel apply mortar mix to average thickness as recommended by the product manufacturer. Tamp into place filling voids at spalled or voided areas.

C. For patching honeycomb, trowel mortar onto surface, work mortar into honeycomb to bring surface flush with surrounding area. Finish trowel surface to match surrounding area.

D. Cover exposed steel reinforcement with epoxy mortar, feather edges to flush surface.

3.5 APPLICATION - CEMENTITIOUS MORTAR

A. Apply by spray, brush or roller coating of bonding agent to damp concrete surfaces. Provide full surface coverage.

B. Apply cementitious mortar by steel trowel to average thickness as recommended by the product manufacturer. Tamp into place filling voids at spalled or voided areas. Work mix into honeycomb.

C. Damp cure cementitious mortar for four days.

3.6 FIELD QUALITY CONTROL

A. Section 01 45 00 - Quality Requirements: Testing, inspection and analysis requirements.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 WORK INCLUDED

A. This item of work includes the formwork and shoring for cast-in-place concrete and the installation into formwork of items such as anchor bolts, pipe and pipe fittings, and other items to be embedded in concrete (but not including reinforcing steel - see Section 03 20 00 - Concrete Reinforcing).

1.2 QUALITY ASSURANCE

A. Codes and Standards

1. The Contractor shall design, construct, erect, maintain, and remove forms and related structures for cast-in-place concrete work in compliance with the American Concrete Institute Standard ACI 347, "Recommended Practice for Concrete Formwork."

B. Allowable Tolerances

1. The Contractor shall construct formwork to provide complete cast-in-place concrete work as follows:

   a. Variation from plumb lines and surfaces: 1/4 inch per 10 feet, but not more than 1 inch. For exposed corners, control joints grooves and other conspicuous lines: 1/4 inch in 20 feet maximum; ½ inch maximum in 40 feet or more. Depressions In Wall Surface: Maximum ¼ inch when 10-foot straightedge is placed on high points in any direction or at any location. Wall Thicknesses: Maximum ¼ inch minus or ½ inch plus from dimension shown.

   b. Variation from level or grade in slabs, and in arises: 1/4 inch in 10 feet, 3/8 inch in 40 feet or more. For exposed horizontal grooves and other conspicuous lines: 1/4 inch in 20 feet maximum and ½ inch in 40 feet or more. Slab Finish Tolerances and Slope Tolerances: Floor surface shall not have crowns so high as to prevent 10-foot straightedge from resting on ¼-inch end blocks, nor low spots that allow a block of twice the tolerance in thickness to pass under the supported 10-foot straightedge. Finish Slab Elevation: Within ½ inch of elevation specified except slabs which are designed and detailed to drain to floor drain or gutter shall adequately drain regardless of tolerances. Repair floor slopes in an approved manner if necessary to provide complete drainage. Thickness: Maximum ¼ inch minus or ½ inch plus from thickness shown.

   c. For beams and columns physical dimensions: Maximum ¼ inch minus or ½ inch plus from dimension shown. Elevations: Within ½ inch plus or minus except where tops of beams become part of finished slab. In this

case refer to slab tolerances. Columns shall be plumb within ¼ inch in any 10 feet with maximum ½ inch out-of-plumb at top with respect to bottom.

d. Forms for sidewalks and driveways shall be standard steel forms or wood forms constructed and fastened to prevent movement. Set forms to true lines and grades, and securely stake in position.

2. Before concrete placement, the Contractor must check the lines and levels of erected formwork. The Contractor shall make corrections and adjustments to ensure proper size and locations of concrete members and stability of forming systems.

3. During concrete placement, the Contractor must check formwork and related supports to ensure that forms are not displaced and that completed work will be within the specified tolerances.

1.3 SUBMITTALS

A. Samples: Prior to start of work, submit one sample each as follows:
   1. Form ties.

1.4 SEQUENCING AND SCHEDULING

A. Schedule work for embedded, buried, or other items of work that affects form layout before completing concrete formwork.

PART 2 PRODUCTS

2.1 FORMS FOR EXPOSED FINISH CONCRETE

A. Unless otherwise shown or specified, the Contractor shall construct formwork for exposed concrete surfaces with plywood, plywood faced metal frames, steel or other panel type materials to provide continuous, straight and smooth as-cast surfaces. The Contractor shall furnish the forms in the largest practicable sizes to minimize the number of joints and to conform to the joint system shown on the construction documents. The Contractor shall provide form material with sufficient thickness to withstand the pressure of the newly placed concrete without bow or deflection.

2.2 FORM TIES

A. The Contractor shall provide factory fabricated, adjustable length, removable or snap-off metal form ties with conical or spherical type inserts, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal. Do not use wire ties.

B. The Contractor shall provide ties so that portion remaining within the concrete after removal of exterior parts is at least 1-1/2 inch from the outer concrete surface except as otherwise specified. Form ties shall be provided which will not leave a hole larger than

1-inch diameter in the concrete surface. The holes shall be filled as per Section 03 30 00 - Cast-in-Place Concrete.

C. Form ties and wire ties fabricated on the project site are not acceptable. Do not use wire ties of any kind. Ties shall withstand form pressures and limit form deflection to specified tolerances. Flat bar ties for panel forms shall have plastic or rubber inserts with minimum 1-inch depth and sufficient dimensions to permit proper patching of tie hole.

D. Water Stop Ties:
1. Provide for water-holding structures or dry structures with access such as basements, pipe galleries, etc., that are below finish grade.
2. Ties shall have either an integral steel water stop 0.103-inch thick and 0.625 inch in diameter tightly and continuously welded to tie, or neoprene water stop 3/16-inch thick and 15/16 inch in diameter whose center hole is ½ diameter of snap tie, or a molded plastic water stop of comparable size.
3. Flat snap ties are not permitted.
4. Water Stop shall be considerably larger in area than tie cross-sectional area, oriented perpendicular to tie and symmetrical about center of tie.
5. Construct ties to provide positive means of preventing rotation or disturbance of center portion of tie during removal of ends and prevent water leaking along tie.

2.3 FORM COATING

A. The Contractor shall provide commercial formulation form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, or impede the wetting of surfaces to be cured with water or curing compounds.

B. For liquid containment structures to be used for potable water applications, all coating and curing compounds shall be ANSI/NSF Standard 61 approved.

C. Form coating (nonstaining form oil) shall be equal to:
1. Nox-Crete Company, Omaha, Nebraska.
2. "Form-Guard," W.R. Grace and Company, Cambridge, Massachusetts.
3. "Rheofinish," Master Builders, Inc.
4. "Formcel," Lambert Corporation, Houston, Texas.

2.4 DESIGN OF FORMWORK

A. The design of forms, shores, and bracing is the responsibility of the Contractor.

B. The Contractor shall design, erect, support, brace, and maintain formwork so that it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Formwork shall be constructed so that concrete members and structures are of correct size, shape, alignment, elevation, and position.

C. The Contractor shall provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Trussed supports shall be provided when adequate foundations for shores and struts cannot be secured.

D. The Contractor shall support form facing materials by structural members spaced sufficiently close to prevent deflection. Forms placed in successive units for continuous surfaces shall be fitted to accurate alignment, free from irregularities, and within allowable tolerances.

E. Design joints in forms to remain watertight and withstand placing pressures without bulging outward or creating surface patterns. Do not use formwork that leaks mortar.

F. Where poor formwork is used and finish obtained is less than specified, upgrade finish to an acceptable finish at no additional cost.

G. Panel Deflections: Limit as required to achieve tolerances specified herein.

H. For circular structures, forms shall conform to circular shape of structure. Straight panels may be substituted for circular forms if they do not exceed 2 feet in width and in addition to the requirement each panel does not provide an angular deflection more than 3½ degrees per joint, and do not conflict otherwise with these Specifications and/or Drawings.

I. Design shall account for tolerances, form ties, finishes, architectural features, rebar supports, construction joint locations, and other nonstructural formwork requirements specified.

J. Design formwork strong enough to hold high liquid heads without form distortion and to meet tolerances as specified herein. Coordinate form design with admixture company information and concrete slump.

K. Structurally design forms, falsework, shoring, and other structural formwork and meet applicable safety regulations, current OSHA regulations, and other codes.

L. A licensed engineer shall prepare formwork, falsework, and shoring designs to meet these Specifications and to meet all federal and state requirements.

M. Meet applicable portions of ACI 347, ACI 318 current edition, and these Specifications.

2.5 REINFORCING SPACERS AND REBAR SUPPORTS

A. Columns:
   1. Provide a positive spacer between column reinforcing and column forms to ensure adequate cover.
   2. Remove spacer as concrete is placed, consolidated, and proper support and spacing is achieved.

B. Walls:

1. Provide positive spacers or chairs specifically designed for wall forms to hold forms and reinforcing at correct dimensions and clearances.
2. Remove spacer or chair if not designed to remain in place as concrete is placed, consolidated, and proper support and spacing is achieved.

C. Slabs:
1. Provide positive spacers, chairs or concrete dobies to support reinforcing steel to the height noted on the plans. Place support sufficient to maintain rebar spacing to the bottom of the slab.
2. Use concrete dobies to support reinforcement when forming is not used at the bottom of the slab.
3. Rocks or masonry bricks are not allowed as rebar support.

PART 3 EXECUTION

3.1 FORM CONSTRUCTION

A. General: The Contractor shall construct forms complying with ACI Standards 318 and 347, to the exact sizes, shapes, lines, and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in finish structures. All necessary detail work, construction aids, and embedded items shall be provided as required.

B. The Contractor shall fabricate forms for easy removal without hammering or prying against concrete surfaces. Crush plates or wrecking plates shall be provided where stripping may damage cast concrete surfaces. Kerf wood inserts shall be provided for forming keyways, reglets, recesses, chamfers and the like, to prevent swelling and assure ease of removal.

C. Forms for Exposed Concrete:
1. The Contractor shall drill forms to suit the ties used and to prevent leakage of concrete mortar around the tie holes. The Contractor shall not splinter forms by driving ties through improperly prepared holes.
2. The Contractor shall not use metal cover slates for patching holes or defects in forms.
3. The Contractor shall provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections shall be provided.
4. The Contractor shall use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Narrow strips of form material which will allow the forms to bow shall not be used.
5. The Contractor shall assemble forms so that they may be readily removed without damage to exposed concrete surfaces.
6. The Contractor shall place carefully and accurately all bracing to prevent sagging or misalignment.
7. All forms shall be new or in first class condition free from holes, indentations, or irregular surfaces.

8. The exposed concrete joints shall be formed with special care to assure proper alignment and uniform cross section.
9. The Contractor shall form molding shapes, recesses and projections with smooth finish materials, and install these in the forms with sealed joints to prevent displacement.

D. Cleaning and Tightening:
1. The Contractor shall thoroughly clean forms and adjacent surfaces to receive concrete. All chips, wood sawdust, dirt, or other debris shall be removed just before concrete is to be placed. All forms shall be re-tightened immediately after concrete placement as required to eliminate leaks.

3.2 FORM COATINGS

A. The Contractor shall coat the contact surfaces of forms with form-coating compound before steel reinforcement is placed. No form coating shall be allowed on steel reinforcement or on previously cast concrete sections which abut the new concrete pour.

B. The Contractor shall thin form-coating compounds only with the thinning agent of type and in amount and under the conditions recommended by the coating compound manufacturer. Excess form-coating material shall not be allowed to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. All form coatings shall be applied in compliance with the manufacturer's instructions.

C. Steel forms shall be coated with a non-staining, rust-preventative form oil or otherwise to protect against rusting. Rust-stained steel formwork will not be accepted. Coat contact surfaces of forms with a light uniform film (a coverage rate of 1,200 square feet per gallon or higher) of the surface consolidation agent. Apply to steel forms as soon as they are cleaned to prevent discoloration of concrete form rust. Do not get surface consolidation agent on concrete surfaces or reinforcing steel against which fresh concrete will be placed.

3.3 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of the items to be attached thereto. Securely anchor embedded items to prevent displacement during placement of concrete.

B. Edge Forms and Screed Strips for Slabs:
1. The edge forms or bulkheads and intermediate screed strips for slabs shall be set to obtain the required elevations and contours in the finished slab surface. The Contractor shall provide and secure units to support the types of screeds required.

C. Prevent metals of dissimilar types from coming in contact with reinforcement.

3.4 BEVELED EDGES (CHAMFER)

A. Form 3/4-inch bevels at concrete edges, unless otherwise shown.

B. Where beveled edges on existing adjacent structures are other than 3/4 inch, obtain Engineer's approval of size prior to placement of bevel form strip.

3.5 REMOVAL OF FORMS

A. General: Formwork not supporting concrete, such as sides of walls, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees Fahrenheit for 24 hours after placing concrete, provided; (1) concrete strength is sufficient to withstand damage by form removal operation and the forces acting on it, and (2) that curing and protection operations are maintained.

B. Formwork supporting the weight of concrete, such as slabs and other structural elements, may not be removed in less than 14 days, and not until the concrete has attained the minimum 28-day compressive strength as indicated by field cured test cylinders taken from that placement.

C. Contractor shall assume responsibility for damage resulting from improper and premature removal of forms.

D. Satisfy applicable OSHA requirements with regard to safety of personnel and property.

E. Do no remove supports and reshore prior to obtaining adequate field cured cylinder results.

3.6 CONCRETE FINISHES

A. As specified in Section 03 30 00 - Cast-in-Place Concrete.

3.7 BACKFILL AGAINST WALLS

A. Do not backfill against walls until concrete has obtained compressive strength equal to specified 28-day compressive strength.

B. Place backfill simultaneously on both sides of wall where required to prevent differential pressures.

C. For liquid containment structures, do not backfill against walls until the leak test has been passed and results received by the Engineer.

3.8 FIELD TESTS

A. Wall Finish Tolerances: Test for compliance with tolerances as specified.

B. Slab Finish Tolerances and Slope Tolerances:

1. Floor flatness measurements will be made the day after floor is finished and before shoring is removed, to eliminate effect of shrinkage, curling, and deflection.
2. Support 10-foot long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
3. Compliance with designated limits in four of five consecutive measurements is satisfactory unless obvious faults are observed.
4. A check for adequate slope and drainage will also be made to confirm compliance with these Specifications.

C. Finish Tolerance Failures: Repair or replace concrete as specified in Section 03 30 00 - Cast-in-Place Concrete.

3.9 REUSE OF FORMS

A. All forms to be reused shall be clean and surfaces repaired to be reused in following work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable. The Contractor shall apply new form-coating compound material to concrete contact surfaces as specified for new formwork.

B. When forms are extended for successive concrete placement, the Contractor shall thoroughly clean all surfaces, remove fins and laitance, and tighten forms to close all joints. All joints shall be secured and tightened to avoid offsets.

END OF SECTION

SECTION 03 15 16
CONCRETE EXPANSION AND CONSTRUCTION JOINTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Concrete expansion, construction and control joints.

B. Concrete joint fillers.

1.2 SUBMITTALS

A. Product Data: Furnish for the following:
   1. Joint fillers for horizontal and sloped joints.
   2. Preformed control joints.
   3. Water stop.
   4. Adhered strip seal.
   5. Sealants.

B. Shop Drawings: Furnish information listed below:
   1. Plastic Type Water Stops: Details of construction joint types; show in sufficient detail water stop support used in both concrete pours to demonstrate water stop will remain secure until complete encasement.
   2. Construction Joints: Layout and location indicating type to be used.

C. Quality Control submittals: Furnish the following documents:
   1. Water stop manufacturer's written instructions for product shipment, storage, handling, installation and repair.
   2. Joint Filler and Primer: Manufacturer's written instructions for product shipment, storage, handling, application, and repair.
   3. Adhered strip seal manufacturer’s written instructions for product shipment, storage, handling, application, and repair.

D. Samples: Submit two 1 inch long samples of joint filler.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Prepare and protect materials for shipment in accordance with manufacturer's recommendations.

B. Acceptance at Site: Verify that water stops delivered meet the cross-section dimensions shown and manufacturer's reviewed product data prior to unloading and storage at the site.

C. Protect hydrophilic water stop from premature exposure to moisture which may cause premature swelling of water stop. Protect from oil, dirt, and sunlight.

PART 2 PRODUCTS

2.1 BOND BREAKER TAPE FOR EXPANSION JOINT

A. Adhesive-backed glazed butyl or polyethylene tape which will adhere to the premolded joint material or concrete surface.

B. Width: Same as the joint.

C. Location: As shown.

2.2 BOND BREAKER

A. Provide either bond breaker tape as hereinbefore specified or a bond prevention material, nonstaining type, as specified in Section 03 30 00 - Cast-in-Place Concrete, except where a tape is specifically called for.

2.3 PREMOLDED JOINT FILLER (PJF)

A. Bituminous Type: ASTM D994 or D1751.

B. Sponge Rubber: Neoprene, closed-cell, expanded; ASTM D1056, Type RE-45-E1, with a compression deflection, 25 percent deflection (limits), 119 to 168 kPa (17 to 24 psi) minimum.

C. Closed-Cell Neoprene: ASTM D1752, Type I; as manufactured by W.R. Meadows, Inc., Elgin, IL; or equal.

2.4 PREFORMED CONTROL JOINT

A. One-piece, flexible, polyvinyl chloride joint former; Kold-Seal Zip-Per Strip KSF-150-50-50, manufactured by Vinylex Corp., Knoxville, TN; or equal.

B. One-piece steel strip with preformed groove; Keyed Kold Retained Kap, manufactured by Burke Concrete Accessories, Inc., San Mateo, CA; or equal.

C. Provide in full-length unspliced pieces.

D. Provide only where specifically permitted by Drawings.

2.5 POURABLE JOINT FILLERS

A. Manufacturers and Products:
   1. Sikaflex 2C, Colonial White color only, as manufactured by Sika Chemical Company, Lyndhurst, NJ; or equal.
   2. On sloping joints, use Gun Grade material of the above products of Sikaflex 1A similar nonsag material; submit product information for review and acceptance.
   3. Or equal.

B. For water containment structures, pourable joint filler shall be approved for use in potable water supply systems. The specific gravity of the in-place filler after curing shall be greater than 1.5. The manufacturers of the following fillers shall provide written certification that the products are approved by the EPA and the State Department of Health for use in potable water supply systems, and will not be a hazard to health.

2.6 STEEL EXPANSION JOINT DOWELS

A. Dowels: Round smooth steel bars; ASTM A36.

B. Bar Coating: Two-coating system No. 29A, FUSION BONDED, STEEL DOWEL COATING, as specified under Section 09 90 00 – Painting and Coating.

2.7 ADHERED STRIP SEAL

A. Epoxy Adhesive: Two components, 100% solids, moisture-unsensitive, high-modulus, high-strength, structural epoxy paste adhesive, complying with ASTM C-881.

Epoxy Adhesive Properties				
SHELF LIFE	2 years in original, unopened containers.			
STORAGE CONDITIONS	Store dry at 40-95F. Condition material to 65-85F before using.			
COLOR	Concrete gray.			
MIXING RATIO	Component 'A': Component 'B' = 2:1 by volume.			
CONSISTENCY	Non-sag paste.			
POT LIFE	Approximately 30 minutes @ 73F. (60 gram mass)			
TACK-FREE TIME	2-3 hours.			
TENSILE PROPERTIES (ASTM D-638)				
14 day Tensile Strength			3,600 psi	
Elongation at Break			0.4 %	
Modulus of Elasticity			7.5×10^5 psi	
FLEXURAL PROPERTIES (ASTM D-790)				
14 day Flexural Strength (Modulus of Rupture)			4,400 psi	
Tangent Modulus of Elasticity in Bending			1.0×10^5 psi	
SHEAR STRENGTH (ASTM D-732)				
14 day Shear Strength			3,400 psi	
BOND STRENGTH (ASTM C-882): Hardened Concrete to Hardened Concrete				
2 day (moist cure)	Bond Strength		2,300 psi	
14 day (moist cure)	Bond Strength		2,400 psi	
2 day (dry cure)	Bond Strength		3,300 psi	
DEFLECTION TEMPERATURE (ASTM D-648)				
7 day Deflection Temperature (fiber stress loading = 264 psi)			128F	
WATER ABSORPTION (ASTM D-570)				
24 hour Total Water Absorption			0.79%	
COMPRESSIVE PROPERTIES (ASTM D-695)				
Compressive Strength, psi		40F	73F	90F
2 hour		--	--	900
4 hour		--	140	5,400
8 hour		--	6,800	8,800
16 hour		400	9,600	10,100
1 day		3,900	9,800	11,700
3 day		6,700	11,300	11,900
7 day		9,100	12,000	13,000
14 day		10,400	12,000	13,000
28 day		11,200	12,000	13,000
MODULUS OF ELASTICITY, PSI				
7 day			3.9×10^5	

B. Hypalon Strips: Provide hypalon strips of width indicated by drawings and minimum 20 foot lengths. Minimum hypalon thickness shall be 40 mils. Minimum physical properties as follows:

SIKA HYPALON STRIP

TENSILE PROPERTIES (ASTM D-412) *Elongate at Break: 800 %* *Tensile Strength: 1300 psi*
TEAR RESISTANCE (ASTM D-624) *250 lbs/in.*
LOW TEMPERATURE PERFORMANCE MAINTAINED TO -40N F. (-40N C.)

C. Provide product equal to: “Sikadur Combi-flex”, Sika, Aurora, CO.

2.8 ACCESSORIES

A. Joint Sealant: Joint sealant shall be two-part polysulfide or urethane conforming to FS TT-S-00227. The type used shall be specifically intended for exterior, submerged control joint applications. A non-sag joint sealant shall be used for vertical joints and self-leveling for horizontal joints.

B. Nonshrink Grout:
1. As specified in Section 03 30 00 - Cast-in-Place Concrete.
2. Compatible with joint sealant.

C. Roofing Felt: 30-pound asphalt-saturated; ASTM D226, Type II; or a tar-saturated roofing felt of equal quality.

D. Reinforcing Steel: As specified in Section 03 20 00 - Concrete Reinforcing.

E. Nails: Provide for securing bituminous type premolded joint filler.

PART 3 EXECUTION

3.1 GENERAL

A. Locate joints as shown, or noted on the Drawings.

B. Verify conformance of water stops with dimensions shown and with reviewed product data prior to embedding water stops in concrete.

C. Construct straight joints; make vertical or horizontal, except where walls intersect sloping floors.

D. Commence concrete placement after the joint preparation is complete.

E. Time Between Concrete Pours:
1. At least 2 hours must elapse after depositing concrete in long or high columns and/or heavy walls before depositing concrete in beams, girders, or slabs supported thereon.
2. For short columns and low height walls, 10 feet or less, wait at least 45 minutes prior to depositing concrete in beams, girders, brackets, column capitals, or slabs supported thereon.

3. Consider beams, girders, brackets, column capitals, and haunches as part of the floor or roof system and place monolithically with the floor or roof system.
4. Should concrete placement sequence result in a cold joint located below the ground water surface, or for a liquid containment structure, below the finished contained water surface, install water stop in joint prior to additional concrete placement. Notify Engineer prior to installing water stop. Engineer shall approve preparations prior to concrete placement.

3.2 SURFACE PREPARATION

A. Construction Joints: Prior to placement of abutting concrete, clean contact surface:
   1. Remove laitance and spillage from reinforcing steel and dowels.
   2. Roughen surface to a minimum of ¼-inch amplitude:
      a. Sandblast after the concrete has fully cured.
      b. Water blast after the concrete has partially cured.
      c. Green cut fresh concrete with high pressure water and hand tools.
   3. Perform cleaning so as not to damage water stop, if one is present.

B. Expansion Joint with Pourable Filler:
   1. Use motorized wire brush or other motorized device to mechanically roughen and thoroughly clean concrete surfaces on each side of joint from plastic water stop to the top of the joint.
   2. Use clean and dry high pressure air to remove dust and foreign material, and dry joint.
   3. Prime surfaces before placing joint filler.
   4. Avoid damage to water stop, if one is present.

C. Control Joint:
   1. Verify that proper type and size of reinforcing and dowels are provided.
   2. When water stop is present:
      a. Coat concrete surfaces above and below plastic water stop with bond breaker. Do not get bond breaker on water stop.
      b. Avoid damage to water stop.

3.3 EXPANSION JOINT INSTALLATION

A. General:
   1. Place bond breaker above and below water stop when premolded joint filler and pourable joint filler is not used.
   2. Premolded Joint Filler:
      a. Sufficient in width to completely fill the joint space where shown.
      b. If a water stop is in the joint, cut premolded joint filler to butt tightly against the water stop and the side forms.
   3. Precut premolded joint filler to the required depth, as detailed, at locations were joint filler or sealant is to be applied.

4. Form cavities for joint filler with either precut, premolded joint filler, or smooth removable accurately-shaped material.
5. Vibrate concrete thoroughly along the joint form to produce a dense, smooth surface.

B. Bituminous Type Premolded Joint Filler:
1. Drive nails approximately 1 foot 6 inches on center through the filler to provide anchorage embedment into concrete prior to concrete placement.
2. Secure premolded joint filler in forms before concrete is placed.
3. Install in walks, at changes in direction at intersections, and at each side of driveway entrances.

C. Pourable Joint Filler:
1. General: Install in accordance with the manufacturer's written instructions, except as specified below:
    a. Apply primer prior to pouring joint filler.
    b. Fill entire joint above the water stop with joint filler as shown.
    c. Use masking tape on top of slabs at sides of joints; clean all spillage.
2. Place cold-applied, two-component fillers in accordance with manufacturer's written instructions.

D. Steel Expansion Joint Dowels:
1. Install coated bars parallel to wall or slab surface and in true horizontal position perpendicular to the joint in both plan and section views so as to permit joint to expand or contract without bending the dowels.
2. Secure dowels tightly in forms with rigid ties.
3. Install reinforcing steel in the concrete as shown to protect the concrete on each side of the dowels and to resist any forces created by joint movement.

3.4 CONTROL JOINT INSTALLATION

A. Locate reinforcing and/or dowels as shown.

B. Install PVC water stop or hydrophilic water stop as shown on the Drawings.

C. Concrete surface to be dense and smooth.

D. Install bond breaker to concrete surfaces above and below water stop, if one is present.

3.5 PREFORMED CONTROL JOINTS

A. Use only where specifically shown.

B. Locate flush, or slightly below the top of slab.

C. Install in accordance with manufacturer's written instructions in straight, full-length unspliced pieces.

D. Steel Strip Type with Preformed Groove: Brace to with-stand pressure of concrete during and after placement.

3.6 ADHERED STRIP SEAL

A. Clean surfaces, place adhesive, and install hypalon strip in accordance with manufacturer's instructions.

END OF SECTION

SECTION 03 20 00
CONCRETE REINFORCING

PART 1 GENERAL

1.1 WORK INCLUDED

A. Fabrication of steel reinforcement for cast-in-place concrete structures, including bars, ties, supports, and welded wire fabric.

B. Placement of steel reinforcement for cast-in-place concrete structures.

1.2 SUMMARY

A. Section Includes:
   1. Reinforcing bars.
   2. Welded wire fabric.
   3. Reinforcement accessories.

1.3 RELATED SECTIONS:

A. Section 03 10 00 - Concrete Forming and Accessories.

B. Section 03 30 00 - Cast-In-Place Concrete.

1.4 REFERENCES

A. American Concrete Institute:
   1. ACI 301 – Specifications for Structural Concrete.
   2. ACI 318 – Building Code Requirements for Structural Concrete.
   3. ACI PRC-315 – Guide to Presenting Reinforcing Steel Design Details.
   4. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures.

B. ASTM International:
   1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
   3. ASTM A185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete aReinforcement.
   5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.

6. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
7. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
8. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
9. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
10. ASTM A775 - Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
11. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
12. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.
13. ASTM A996 - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.

C. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.
2. AWS D12.1 - Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction.

D. Concrete Reinforcing Steel Institute:
1. CRSI - Manual of Standard Practice.
2. CRSI - Placing Reinforcing Bars.

E. American Association of State Highway and Transportation Officials:
1. AASHTO M31 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
2. AASHTO M32 - Cold Drawn Steel Wire for Concrete.
3. AASHTO M54 - Fabricated Steel Bar or Rod Mats for Concrete Reinforcement.
4. AASHTO M55 - Welded Steel Wire Fabric for Reinforced Concrete.

1.5 QUALITY ASSURANCE

A. The Contractor shall comply with all requirements of the codes and standards (most recent edition) as listed in this Section, except as modified herein.

B. Reinforcing Steel Welders: AWS qualified within previous 12 months.

1.6 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures

B. Manufacturer's Data:
1. The Contractor shall submit the Manufacturer's specifications and installation instructions for all proprietary materials and reinforcement accessories.

C. Shop Drawings:

1. The Contractor shall submit shop drawings for the fabrication, bending, and placement of concrete reinforcement. All work shall comply with the ACI PRC-315 “Guide to Presenting Reinforcing Steel Design Details." Submittals shall indicate bar sizes, spacing, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, supporting and spacing devices, and arrangements and assemblies.
2. The Contractor shall submit certification of grade, chemical analysis and tensile properties of the steel furnished.

1.7 DELIVERY, HANDLING, AND STORAGE

A. All steel reinforcement delivered to the project site shall be bundled, tagged, and marked. Metal tags shall be used indicating the bar size, lengths, and other information corresponding to markings shown on placement diagrams in accordance with ACI PRC-315.

B. The Contractor shall store concrete reinforcement materials at the site in a manner that will prevent damage and accumulation of dirt or excessive rust. Store to prevent contact with the ground. Protect all reinforcement from any contact with oil, grease, or petroleum based products of any kind.

1.8 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCING STEEL GRADE

A. Unless otherwise called for on the Drawings, all reinforcing steel for this project shall conform to ASTM A615 Grade 60, except for #3 stirrups or column ties which shall be Grade 40.

B. When called for on the Drawings, epoxy coating shall be in accordance with ASTM D 3963; A775

C. Bar mats shall conform to the requirements of ASTM A184 (AASHTO M54).

2.2 SHOP FINISHING

A. Galvanized Finish for Steel Bars: ASTM A767, Class I, hot dip galvanized after fabrication.

B. Epoxy Coated Finish for Steel Bars: ASTM A775, ASTM D3963.

C. Epoxy Coated Finish for Steel Wire: ASTM A884; Class A using ASTM A775.

2.3 ACCESSORIES

A. Chairs and spacers shall be metal stock, designed for the purpose intended.

B. All accessories shall comply with CRSI "Recommended Practice for Placing Bar Supports, Specifications and Nomenclature."

C. The Contractor shall provide stainless steel accessories for sight-exposed concrete (exterior), and concrete surfaces exposed to moisture or containing water.

D. Slabs on grade where the base material will not support chairs, shall use supports with sand plates, horizontal runners or dobies to properly locate steel reinforcing in the slab.

E. Wire-bar type supports shall comply with CRSI recommendations. Wood, brick, or other materials will not be accepted.

F. Tie wire shall be 16-gauge, black, soft-annealed wire. Tie wire shall not be closer than 1-inch from surface of wall or slab after tying in place.

G. In epoxy coated applications, tie wire shall be epoxy coated.

2.4 WELDED WIRE FABRIC

A. Welded-wire fabric shall be electrically welded, 65,000 psi yield strength minimum, and shall conform to ASTM A185 or A497 (AASHTO M55) and ACI 318, latest edition.

2.5 SPIRAL REINFORCING FOR COLUMNS

A. Spiral reinforcement shall meet ASTM A615, Grade 60.

2.6 SPLICES AND MECHANICAL CONNECTIONS

A. Metal Sleeve: If used for splice, provide with cast filler metal, capable of developing in tension or compression 125 percent of specified yield strength of the bar, as manufactured by:
   1. Erico Products, Inc., Cleveland, OH, Cadweld C-Series.
   2. Or equal.

B. Mechanical Threaded Connections: Metal coupling sleeve with internal threads which engage threaded ends of bars to be spliced, and develops in tension or compression 125 percent of the specified yield strength of the bar, as manufactured by:
   1. Erico Products, Inc., Cleveland, OH, Lenton Reinforcing Steel Couplers.
   2. Richmond Screw Anchor Co., Inc., Fort Worth, TX, Richmond DB-SAE Dowel Bar Splicers.
   3. Or equal.

PART 3 EXECUTION

3.1 FABRICATION

A. General: The Contractor shall fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with CRSI "Manual of Standard Practice" and ACI 301. In case of fabricating errors, the heating, rebending or straightening of reinforcement will not be permitted.

3.2 GENERAL

A. Meet requirements in the manual titled, "Placing Reinforcing Bars", published by Concrete Reinforcing Steel Institute (CRSI).

B. Steel reinforcement shall be protected at all times from injury. When placed in the work, it shall be free from dirt, detrimental scale, paint, oil and other foreign substances. When steel reinforcement has detrimental rust, loose scale and dust which is easily removable, it shall be cleaned by a satisfactory method, if approved.

C. All bars shall be bent cold, unless otherwise permitted. No bars partially embedded in concrete shall be field bent except as shown on the Drawings or otherwise permitted.

D. Details of concrete reinforcement and accessories not covered herein or on the Drawings shall be in accordance with ACI 315.

E. Notify Engineer when reinforcing is ready for inspection and allow sufficient time for this inspection prior to close-up of the forming system or placing concrete.

3.3 INSTALLATION

A. The Contractor shall clean reinforcement to remove all loose rust and mill scale, earth, ice, oil or grease, and other materials which reduce or destroy the bond between the concrete and reinforcing steel.

B. The Contractor shall position, support, and secure all reinforcement to prevent displacement by formwork, construction loadings, or concrete placement operations. Steel reinforcing shall be located and supported by metal chairs, runners, bolsters, spacers and hangers, as required. The reinforcement shall be placed to obtain the coverage for concrete protection noted on the Drawings. Where the coverage is not shown, the reinforcement shall be placed to obtain at least the minimum coverage specified hereinafter. The Contractor shall arrange, space, and securely tie bars and bar supports together with 16-gauge wire to hold reinforcement accurately and solidly in position during concrete placement operations. Wire ties shall be set so that the twisted ends are directed away from the exposed concrete surfaces. All reinforcement will be tied and secured in the correct position in the forms before placing concrete. Do not stab reinforcing into fresh placed concrete.

C. The Contractor shall provide a sufficient number of supports of adequate strength to carry the reinforcement. Reinforcing bars shall not be placed more than 2 inches beyond the last leg of any continuous bar support. Supports shall not be used as bases for runways for concrete conveying equipment and similar construction loads.

D. Supports or spacers of pebbles, pieces of broken stone, concrete rubble, broken brick or building blocks, metal pipe or wooden blocks will not be permitted.

E. Splices:
1. Standard reinforcement splices shall be done by lapping the ends, placing the bars in contact, and tightly wiring the splice together. The requirements of ACI 318 for minimum lap of spliced bars shall be provided. Use lap splices unless otherwise shown on the Drawings or permitted in writing by the Engineer. Stagger splices minimum of 40 bar diameters in adjacent bars unless otherwise shown on the Drawings or permitted in writing by the Engineer.
2. No field welding or tacking of reinforcement will be permitted.
3. Vertical bars in columns shall be offset at least one bar diameter at lapped splices. To ensure proper placement, templates shall be furnished for all column dowels.

F. Unless otherwise shown on the Drawings, the Contractor shall provide cover as follows:
1. Not less than 3 inches where the concrete is placed against the ground and without use of forms.
2. Not less than 1 1/2-inches for bars smaller than No. 6 and not less than 2-inches for No. 6 bars and larger where concrete is exposed to the weather, water, or in contact with earth, but placed in forms.
3. Not less than 1 1/2-inches for interior slabs, walls, beams, and columns.

G. The Contractor shall provide a minimum of two No. 4 bars in the top and bottom of a slab or wall face at 45 degrees on all four corners at all openings in structural slabs and walls, unless otherwise shown on the Drawings. Bars shall extend on each side sufficiently to develop bond in each bar.

H. The Contractor shall notify the Engineer when reinforcing is in place so that an inspection of reinforcement placement can be made prior to the close-up of formwork or the placement of concrete.

I. Conform to ACI 301 for all placing tolerances.

J. Bars may be moved to avoid interference with other reinforcing steel, conduits, or embedded items. If moved more than one bar diameter or the stipulated tolerance, the Contractor shall consult with the Engineer to determine final placement.

K. At construction joints and before constructing concrete formwork for next stage of construction, the Contractor shall clean all dowels, reinforcing bars and concrete surfaces. All loose material and foreign objects shall be cleaned out of forming before placement of concrete.

L. Placing Welded Wire Fabric:
   1. Extend fabric to within 2-inches of edges of slab, and slab control joints and lap splices at least 1½ courses of fabric or minimum 8-inches.
   2. Tie laps and splices securely at ends and at least every 24-inches with 16-gauge black annealed steel wire.
   3. Place welded wire fabric on #4 continuous bars at 4'-0" at proper distance above bottom of slab. All slab reinforcing is to be discontinuous at slab control joints.
   4. Meet current ACI 318 and current Manual of Standard Practice, Welded Wire Fabric, by the Wire Reinforcement Institute regarding placement, bends, laps, and other requirements.
   5. All welded wire fabric shall be provided in flat sheets. Rolled fabric will not be permitted.

M. Field Bending:
   1. Straightening and Rebending: Do not straighten or rebend metal reinforcement. Field bending of reinforcing steel bars is not permitted.
   2. Unless permitted by Engineer, do not cut reinforcing bars in the field.

3.4 MECHANICAL SPLICES AND CONNECTIONS

A. Install as required by manufacturer with threads tightened as required by referenced ICC Report.

B. Carefully inspect each splice and verify that each component meets manufacturer's and ICC requirements.

C. Maintain minimum edge distance and concrete cover

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03 30 00
GENERAL CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:
   1. Cast-in-place concrete for all construction on project.
   2. Saw cutting and core drilling new or existing concrete.

1.2 RELATED SECTIONS

A. Section 01 30 00 – Submittal Procedures

B. Section 01 40 00 – Quality Requirements

1.3 REFERENCES

A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
   3. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete
   4. ACI 305 – Guide to Hot Weather Concreting.
   5. ACI 306 – Guide to Cold Weather Concreting.
   6. ACI 308 – Guide to External Curing of Concrete.
   7. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:
   1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   2. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   3. ASTM C33 - Standard Specification for Concrete Aggregates.
   4. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   5. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
   7. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
   8. ASTM C150 - Standard Specification for Portland Cement.
   9. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
   10. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
   11. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

12. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
13. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
14. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
15. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
16. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
17. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
18. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
19. ASTM C685 - Standard Specification for Concrete Made By Volumetric Batching and Continuous Mixing.
20. ASTM C845 - Standard Specification for Expansive Hydraulic Cement.
21. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
22. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
23. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
24. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
25. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
26. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
27. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
28. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
29. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
30. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
31. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
32. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
33. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.
34. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
35. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
36. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
37. ASTM E1155 - Standard Test Method for Determining Floor Flatness and of Levelness Using the F-number System.
38. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.

39. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

C. South Coast Air Quality Management District:
1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit data on concrete materials, admixtures, joint devices, water stop, attachment accessories, concrete hardener, sealer, and curing compounds, mats, paper, film, compatibilities, and limitations.

C. Design Data:
1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
   a. Hot and cold weather concrete work.
   b. Air entrained concrete work.
2. Identify mix ingredients and proportions, including admixtures.

D. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

C. Operation and Maintenance Data: Submit data on maintenance renewal of applied coatings.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Conform to ACI 305 when concreting during hot weather.

C. Conform to ACI 306.1 when concreting during cold weather.

D. Acquire cement and aggregate from one source for Work.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Applicator or Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.

B. Maintain concrete temperature after installation at minimum 50 degrees F for minimum 7 days.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

B. Deliver materials in manufacturer's packaging including application instructions.

1.10 COORDINATION

A. Section 01 30 00 - Project Management and Coordination.

B. Coordinate placement of joint devices, concrete curing, and concrete finishing with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement:
   1. ASTM C150, Type I or II.
   2. ASTM C595, Type IP, IL, IT
   3. ASTM C1157, Type GU

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Chemical: ASTM C494 Type A - Water Reducing.

C. Fly Ash: ASTM C618 Class F.

D. Silica Fume: ASTM C1240.

E. Slag: ASTM C989.

F. Plasticizing: ASTM C1017 Type I, plasticizing

G. Substitutions: Section 01 60 00 - Product Requirements.

2.3 ACCESSORIES

A. Vapor Retarder: ASTM E1745 Class A; 6 mil thick clear polyethylene film; type recommended for below grade application. Furnish joint tape recommended by manufacturer.

B. Non-Shrink Grout: ASTM C1107, Grade A; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

C. Concrete Reinforcing Fibers: ASTM C1116, high strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete. Tensile strength -130 ksi toughness 15 ksi; ¾ inch long fibers, 34 million/lb. fiber count.

1. Manufacturers:

   a. Nycon.
   b. Substitutions: Section 01 60 00 - Product Requirements

2.4 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler: See Section 03 15 16 – Concrete Expansion and Construction Joints.

2.5 CONCRETE MIX

A. Provide concrete to the following criteria unless otherwise specified on the drawings:

1. M4000-STD: Standard structural concrete mix for non-water retaining structural concrete including foundation walls, above grade structural walls, columns, piers, slabs, beams and all other structural concrete:

Strength @ 7 days	2400 psi
Strength @ 28 days	4000 psi
Admixture:	Mid-range water reducer conforming to ASTM C494.
Maximum water/cement + fly ash ratio	0.45 by weight
Slump @ point of placement	4 inches
Entrained Air	6% ± 1.5%
Maximum Aggregate Size	3/4 inch, as defined below, unless otherwise shown on the Drawings.

2. M-CDF: Mix for Controlled Density Fill (CDF) or Controlled Low Strength Material (CLSM). CDF shall be a mixture of cement, fine and coarse aggregate, fly ash and admixtures formulated to be flowable and self-consolidating with a net 28 day compressive strength of 200 to 300 psi.

B. Design shall be by an approved independent testing laboratory and a trial mix batch shall be made and tested by that laboratory. Average strength of cylinders in trial batch must exceed specified strength by 15%.

C. A previously used mix design may be used provided aggregate source is the same, the mixing equipment is the same, and provided at least 10 tests were made by an independent laboratory with results meeting these specifications.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to the Owner. Test data for revised mix designs and strength results must be submitted and accepted before using the mix adjustments.

E. Entrained Air: Air-entraining admixture shall be used unless otherwise shown or specified. Air-entraining admixture shall be added at the manufacturer's prescribed rate to result in concrete at the point of placement with an air content as specified herein (volume basis).

F. Use accelerating admixtures in cold weather only when approved by Engineer. Use of admixtures will not relax cold weather placement requirements.

G. Use of calcium chloride will not be permitted.

H. Use set retarding admixtures during hot weather only when approved by Engineer.

I. Average Compressive Strength Reduction: Permitted in accordance with ACI 318

J. Ready Mixed Concrete: Mix in accordance with ACI 301 and deliver concrete in accordance with ASTM C94.

K. Site Mixed Concrete: Mix concrete in accordance with ACI 301.

2.6 CONCRETE SEALER

A. Manufacturers:
1. Master Builders Solutions, MasterKure.
2. Dayton Superior Corp., Cure & Seal.
3. ChemMasters, Safe-Cure & Seal.

2.7 CURING MATERIALS

A. Membrane Curing Compound: Compound conforming to ASTM C309 or ASTM C1315 Type I, Class A.
   1. Provide manufacturer's certification that curing compound is acceptable to the appropriate state agency or health department.

B. Absorptive Mats: ASTM C171 Type C or AASHTO M 182 Class 2, cotton fabric, burlap-polyethylene, minimum 8 oz./sq. yd. bonded to prevent separation during handling and placing.

C. Polyethylene Film Type E: ASTM C171, 6 mil thick, clear, white, or opaque color.

D. Waterproof paper: ASTM C 171 or AASHTO M 171

E. Water: Potable, not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 – Project Management and Coordination.

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

3.2 PREPARATION

A. Prepare subgrade and base course per Divisions 31 and 32 of specifications.

B. Provide forms that are clean, tight, and in good condition. Brace and support forms securely.

C. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions. Remove laitance, coatings, and unsound materials.

D. In locations where new concrete is doweled to existing work, drill holes in existing concrete, fill with epoxy adhesive and insert steel dowels in accordance with manufacturer's instructions. Finish by packing solid with non-shrink grout as necessary.

E. Remove debris and ice from formwork, reinforcement, and concrete substrates.

F. Remove water from areas receiving concrete and allow to dry sufficiently for proper compaction before concrete is placed.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 301 and 318.

B. Notify testing laboratory and Engineer minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints are not disturbed during concrete placement.

D. Install vapor retarder under interior slabs on grade where called for in the project Drawings in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by adhesive applied between overlapping edges and ends.

E. Repair vapor retarder damaged during placement of concrete reinforcing. Repair with vapor retarder material; lap over damaged areas minimum 6 inches and seal watertight.

F. Install joint fillers and devices in accordance with manufacturer's instructions.

G. Separate slabs on grade from vertical surfaces with ½ inch thick joint filler.

H. Place joint filler and construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

I. Extend joint filler from bottom of slab to within ½ inch of finished slab surface.

J. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor finish.

K. Install joint covers in longest practical length when adjacent construction activity is complete.

L. Apply sealants in joint devices in accordance with manufacturer’s instructions.

M. Deposit concrete at final position. Prevent segregation of mix.

N. Place concrete in continuous operation for each panel or section determined by predetermined joints.

O. Consolidate concrete.

P. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

Q. Place concrete continuously between predetermined expansion, control, and construction joints.

R. Do not interrupt successive placement; do not permit cold joints to occur where not specified.

S. Place floor slabs in checkerboard or saw cut pattern as indicated on the Drawings.

T. Saw cut joints within 12 hours after placing.

U. Screed floors and slabs on grade to match design grades and elevations, maintaining surface flatness of maximum 1/4 inch in 10 ft.

3.4 CONCRETE FINISHING

A. Verify floor surfaces are acceptable to receive the Work of this section.

B. Provide formed concrete surfaces to be left exposed with smooth rubbed finish, unless otherwise indicated.

C. Finish concrete floor surfaces in accordance with ACI 301.

D. Steel trowel surfaces which are indicated to be exposed.

E. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/4 inch per foot nominal or as indicated on Drawings.

F. Maximum Variation of Surface Flatness for Exposed Concrete Floors: 1/8 inch in 10 ft.

G. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work. Areas requiring corrective Work will be identified. Re-measure corrected areas by same process.

H. Apply sealer on floor surfaces.

3.5 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Cure concrete in accordance with ACI 308.

D. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for 5 days.

E. Spraying: Spray water over floor slab areas and maintain wet for 7 days.

F. Do not use curing compound where additional finishes such as hardeners, paintings, and other special coatings are required. Use water curing as specified instead.

G. Spread absorptive mat over floor slab areas. Spray with water until mats are saturated and maintain in saturated condition for 7 days.

H. Apply curing compound. Manufacturer's certification shall state that curing compound can be applied in one or two coats and shall show the quantity or coverage required to meet or exceed that above moisture retention. If two coats of curing compound are required, apply curing compound with second coat applied at right angles to first.

I. Concrete surfaces protected by formwork require no special curing treatment as long as the formwork remains in place a minimum of 7 days or until the concrete has reached the specified strength.

J. If forms are removed prior to 7 days or the concrete attaining the specified strength, then all surfaces shall be cured as specified in this section for the remainder of the required curing period.

K. Top or other exposed portions of walls and other concrete elements covered with protecting formwork require curing as specified in this section.

L. In hot weather, wall forms shall be hosed down with water and covered with protective polyethylene film to prevent excessive moisture loss.

M. Do not permit traffic over unprotected floor surface.

3.6 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01 40 00 – Quality Control.

B. Provide free access to Work and cooperate with appointed testing firm(s).

C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.

D. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.

E. Three concrete test cylinders will be taken for every 30 or less cu yds of concrete placed.

F. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. One slump test will be taken for each set of test cylinders taken.

H. Air Entrainment Test: Accurately measure the amount of entrained air using ASTM C173 or ASTM C231 testing method for all concrete pours. One air content test will be made for each set of test cylinders taken.

3.7 CONCRETE REPAIRS

A. All concrete repairs are to be done in conformance with Section 03 01 00 – Maintenance of Concrete.

3.8 PATCHING

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections as directed in accordance with ACI 301.

3.9 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Repair or replacement of defective concrete will be determined by the Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.10 REJECTIONS

A. Concrete Strength: Concrete strength shall be considered satisfactory if the average test of the two 28-day specimens exceeds the specified strength and neither specimen test falls below 95% of the specified strength. If the average strength of the two test specimens is less than specified and either specimen test is less than 95% of the specified strength, the concrete represented by the tests is rejected and must be removed and replaced at the Contractor's expense.

1. For concrete that is rejected but does not pose a life safety factor or is detrimental to any part of the Work as determined by the Engineer, the Owner may accept the concrete at a reduced price according to the following pay factors:

Price Reduction Factors for 28 Day Compressive Strength	
Percent of Specified Strength Achieved	Pay Factor
95%	0.86
90%	0.72
85%	0.60
80%	0.48
75%	0.38
70%	0.28
65%	0.20
60%	0.12
<60%	0

2. The pay factor for percentages not specified shall be interpolated based on the given values.

3. The pay factor will be applied to the quantity of the concrete that is represented by the strength tests that fall below a specified strength.

B. Alignment: Where concrete slabs or walls do not meet the alignment requirements, the Contractor must grind off irregularities until they comply. However, if such removal leaves less concrete section than indicated, the Engineer may reject concrete if he feels the remaining section would not be adequate.

C. Flatwork: Finished flatwork exceeding the tolerances of these specifications shall be repaired or replaced so that strength or appearance is not adversely affected. Follow paragraph 3.07 for repair work or as directed by Engineer.

D. Appearance: Concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired, if possible in accordance with paragraph 3.07. If, in the opinion of the Engineer, the defects cannot be repaired to equal the specified finish, the concrete shall be rejected.

E. Misplaced Members: Concrete members cast in the wrong location may be rejected if the strength, appearance, or function of the structure is adversely affected or misplaced items interfere with other construction.

F. Rejected Concrete: Rejected concrete shall be removed and replaced. Limits of removal shall be as directed by the Engineer to accomplish a structure equal in strength, serviceability, and appearance, to that which would have been achieved by acceptable concrete.

G. Expense of Repairs: The cost of all repairs, removal, replacement, etc., required by the provisions of this Article shall be borne by the Contractor.

3.11 SAWCUTTING AND CORE DRILLING

A. Demonstrate to the Engineer, prior to commencing Work, that sawcutting/core drilling machinery and personnel are capable of completing this Work in accordance with the Contract Documents to the satisfaction of the Engineer.

B. Utilize industry standard core-drilling machines and sawing machines to create or enlarge openings. Openings shall be smooth and properly located.

C. Minimize overrun at corners when saw cutting. Fill slots with epoxy adhesive.

D. Coat cut faces with Carboline Bitumastic 300M to protect exposed rebar.

E. Cuttings and wastewater must be disposed of off-site.

F. Tolerances:
1. Circular openings: Concentric + 1/16inch out-of-round or less as required by piping connector or slide gate manufacturer. Invert location + 1/8 inch.
2. Square or rectangular openings: + 1/16 inch or less as required by slide gate manufacturer. Invert location + 1/8 inch.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 04 05 13
MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes mortar and grout for masonry.

1.2 REFERENCES

A. ASTM International:
1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
2. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
3. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
4. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
5. ASTM C150 - Standard Specification for Portland Cement.
6. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
7. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
8. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
9. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
10. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
11. ASTM C476 - Standard Specification for Grout for Masonry.
12. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
13. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
14. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
15. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
16. ASTM C1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
17. ASTM C1329 - Standard Specification for Mortar Cement.
18. ASTM C1357 - Standard Test Method for Evaluating Masonry Bond Strength.

B. The Masonry Society:
1. TMS MSJC - Building Code for Masonry Structures (TMS 402), Specification for Masonry Structures (TMS 602) and Commentaries.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal requirements.

B. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

C. Test Reports:
   1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270.
   2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476.

D. Manufacturer's Installation Instructions: Submit premix mortar manufacturer's installation instructions.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TMS MSJC Code and TMS MSJC Specification.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 – Product Requirements.

B. Hot and Cold Weather Requirements: TMS MSJC Specification.

PART 2 PRODUCTS

2.1 MORTAR AND MASONRY GROUT

A. Manufacturers:
   1. The Quikrete Companies Model.
   2. Substitutions: Section 01 60 00 – Product Requirements.

2.2 COMPONENTS

A. Portland Cement: ASTM C150, Type I, gray color.

B. Blended Cement: ASTM C595, Type I, gray color.

C. Premix Mortar: ASTM C387, Type S, using gray color cement.

D. Mortar Aggregate: ASTM C144, standard masonry type.

E. Hydrated Lime: ASTM C207, Type S.

F. Grout Aggregate: ASTM C404, fine and coarse.

G. Water: Clean and potable.

H. Calcium chloride is not permitted.

2.3 MIXES

A. Mortar Mixes:
1. Mortar For Structural Masonry: ASTM C270, Type S using Proportion specification. Compressive strength at 28 days of 1,800 PSI

B. Mortar Mixing:
1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
2. Achieve uniformly damp sand immediately before mixing process.
3. Add mortar color and admixtures to achieve uniformity of mix and coloration.
4. Re-temper only within two hours of mixing.

C. Grout Mixes:
1. Grout for Structural Masonry: 2,500 psi strength at 28 days; 8-11 inches slump; mixed in accordance with ASTM C476 Fine grout.
2. Application:
   a. Coarse Grout: For grouting spaces with minimum 4 inches dimension in every direction.
   b. Fine Grout: For grouting other spaces.

D. Grout Mixing:
1. Mix grout in accordance with ASTM C94, modified to use ingredients complying with ASTM C476.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 – Project Management and Coordination.

B. Request inspection of spaces to be grouted.

3.2 PREPARATION

A. Apply bonding agent to existing concrete surfaces.

3.3 INSTALLATION

A. Install mortar and grout.

3.4 FIELD QUALITY CONTROL

A. Section 01 45 00 – Quality Control: Testing and Inspection Services.

B. Establishing Mortar Mix: In accordance with ASTM C270.

C. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength, and in accordance with ASTM C143/C143M for slump.

D. Test compressive strength of mortar and masonry to ASTM C1314; test in accordance with masonry unit sections specified.

3.5 SCHEDULES

A. Unit Masonry Wall: Unit masonry with Type S mortar

END OF SECTION

SECTION 04 22 00
CONCRETE UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Section includes concrete masonry units.

1.2 REFERENCES

A. ASTM International:
   1. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   2. ASTM C55 - Standard Specification for Concrete Brick.
   3. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
   4. ASTM C90 - Standard Specification for Load Bearing Concrete Masonry Units.
   5. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.

B. The Masonry Society:
   1. TMS 402 - Building Code Requirements for Masonry Structures and Commentary.
   2. TMS 602 - Specification for Masonry Structures and Commentary.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate bars sizes, spacings, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement, accessories.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TMS MSJC Code and TMS MSJC Specification.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

B. Accept decorative units on site. Inspect for damage.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 – Product Requirements.

B. Hot and Cold Weather Requirements: TMS MSJC Specification.

1.8 COORDINATION

A. Section 01 31 00 – Project Management and Coordination.

PART 2 PRODUCTS

2.1 REINFORCED UNIT MASONRY ASSEMBLIES

A. Manufacturers:
   1. Amcor Inc. - Oldcastle Architectural Products.
   2. Sunroc Masonry.
   3. Angelus Block Co.
   4. Basalite Concrete Products
   5. Substitutions: Section 01 60 00 – Product Requirements.

2.2 COMPONENTS

A. Typical Structural Exterior Wall Concrete Masonry Units (CMU): ASTM C90, Type II - Non-moisture Controlled:
   1. Interior: Smooth Face
   2. Exterior: Split Face.
   3. Standard gray block (color to be approved by owner)
   4. 8 x 8 x 16 inches
   5. f'm: 2,000 psi minimum

B. Typical Interior Wall Concrete Masonry Units (CMU): ASTM C90, Type II - Non-moisture Controlled:
   1. Both Wall Faces: Smooth Face
   2. Standard gray block.
   3. 8 x 8 x 16 inches
   4. f'm: 2,000 psi minimum

2.3 ACCESSORIES

A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade, deformed billet bars, uncoated finish.

B. Joint Reinforcement:
   1. Truss Joint Reinforcement: ASTM A 951, Galvanized: ASTM A 153, Class B-2.

2. Ladder Joint Reinforcement: ASTM A 951, Galvanized: ASTM A 153, Class B-2.

C. Anchor Bolts: Headed, J-shaped or L-shaped.

D. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self-expanding; 3/4 inch wide x by maximum lengths.

E. Flashing:
1. Copper: ASTM B 370, 5 oz.
2. Copper: ASTM B 370, 7 oz.
3. Stainless Steel: ASTM A 666, Type 304.
4. Plastic: PVC, 30 mils thick.
5. Combinations:
   a. Plastic/Copper: 5 oz.
   b. Cooper/Fabric: 5 oz.
   c. Asphalt-Coated Copper: 5 oz.
   d. Plastic/Copper: 7 oz.
   e. Cooper/Fabric: 7 oz.
   f. Asphalt-Coated Copper: 7 oz.

F. Weep holes:
1. Plastic Tubes: ¼ inch minimum inside diameter and length to match masonry width.
2. Aluminum Weep/Vents.
3. Plastic Weep/Vents.

G. Mortar and Grout: As specified in Section 04 05 13 – Masonry Mortar and Grout.

H. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 – Project Management and Coordination.

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify items provided by other sections of work are properly sized and located.

D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other Sections.

B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

3.3 INSTALLATION

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.

C. Coursing of Concrete Masonry Units:
1. Bond: Running.
2. Coursing: One unit and one mortar joint to equal 8 inches.
3. Mortar Joints: Concave.

D. Placing And Bonding:
1. Lay solid masonry units in full bed of mortar, with full head joints.
2. Lay hollow masonry units with face shell bedding on head and bed joints.
3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
4. Remove excess mortar as Work progresses.
5. Butt intersections and external corners.
6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
8. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.

E. Joint Reinforcement And Anchorage:
1. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

F. Reinforced Masonry:
1. Lay masonry units with core cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
2. Place reinforcing, reinforcement bars, and grout as indicated on Drawings.
3. Splice reinforcement in accordance with Section Construction Drawing Notes.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout in accordance with TMS MSJC Specification.

G. Control And Expansion Joints:
1. Do not continue horizontal joint reinforcement through control joints.
2. Install preformed control joint device in continuous lengths. Seal butt and corner joints.

3. Size control joint in accordance with Section 07 90 00 – Joint Protection for sealant performance.
4. Form expansion joint by omitting mortar and cutting unit to form open space.

3.4 ERECTION TOLERANCES

A. Section 01 45 00 - Quality Control: Tolerances.

B. Maximum Variation From Alignment of Pilasters: 1/4 inch.

C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

G. Maximum Variation of Joint Thickness: 1/8 inch in 3 ft.

H. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

I. Maximum Variation for Steel Reinforcement:
1. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
2. Plus or minus 1 inch when distance is between 8 and 24 inches.
3. Plus or minus 1 1/4 inch when distance is greater than 24 inches.
4. Plus or minus 2 inches from location along face of wall.

3.5 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Control: Testing and Inspection Services.

B. Concrete Masonry Units: Test each type in accordance with ASTM C140.

3.6 CLEANING

A. Section 01 77 00 – Closeout Procedures: Final cleaning.

B. Remove excess mortar and mortar smears as work progresses.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated metal items.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 03 30 00 - Cast-In-Place Concrete: Placement of metal fabrications in concrete.

B. Section 03 10 00 – Concrete Forming and Accessories: Anchor for casting into concrete.

1.3 REFERENCES

A. Aluminum Association:
   1. AA DAF-45 - Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association:
   1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
   2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
   3. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
   4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

C. ASTM International:
   1. ASTM A36 - Standard Specification for Carbon Structural Steel.
   2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   6. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

7. ASTM A276 – Standard Specifications for Stainless Steel Bars and Shapes.
8. ASTM A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
9. ASTM A297 - Standard Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application.
10. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
11. ASTM A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
12. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
13. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
14. ASTM A386 - Zinc-Coating (Hot-Dip) on Assembled Steel Products.
15. ASTM A479 - Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
16. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
17. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
18. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
19. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
20. ASTM A572 - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
21. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
22. ASTM A992 - Standard Specification for Structural Steel Shapes.
23. ASTM B26 - Standard Specification for Aluminum-Alloy Sand Castings.
24. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings.
25. ASTM B177 - Standard Guide for Chromium Electroplating on Steel for Engineering Use.
26. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
27. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes.
28. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire.
29. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
30. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
31. ASTM F436 - Standard Specification for Hardened Steel Washers Inch Dimensions.
32. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
33. ASTM F594 - Standard Specification for Stainless Steel Nuts.

34. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
35. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

D. American Welding Society:
1. AWS A2.0 - Standard Welding Symbols.
2. AWS D1.1 - Structural Welding Code - Steel.
3. AWS D1.6 - Structural Welding Code - Stainless Steel.

E. Green Seal:
1. GC-03 - Anti-Corrosive Paints.

F. National Ornamental & Miscellaneous Metals Association:
1. NOMMA Guideline 1 - Joint Finishes.

G. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.
2. SSPC SP 1 - Solvent Cleaning.
3. SSPC SP 10 - Near-White Blast Cleaning.
4. SSPC Paint 15 - Steel Joist Shop Paint.
5. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal requirements.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

1.5 QUALIFICATIONS

A. Welders Certificates: Prior to start of work, submit to Engineer under provisions of Section 01 33 00 – Submittal Procedures, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.6 QUALITY ASSURANCE

A. Finish joints in accordance with NOMMA Guideline 1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept metal fabrications on site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather.

1.8 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on Drawings.

PART 2 PRODUCTS

2.1 MATERIALS

A. CARBON STRUCTURAL STEEL
1. Structural W-Shapes: ASTM A992.
2. Structural Plates, Bars, Channels & Angles: ASTM A36.
3. Structural Tubing: ASTM A500, Grade B.
4. Plates: ASTM A283 or A36.
5. Pipe: ASTM A501 or A53 Type E or S Grade B Fy= 35 ksi.
6. Bolts: ASTM A307; Grade A or B.
    a. Finish: Hot dipped galvanized
7. High Strength Bolts: ASTM F3125 (formerly A325); Type 1
    a. Finish: Hot dipped galvanized
8. Nuts: ASTM A563 heavy hex type.
    a. Finish: Hot dipped galvanized
9. Washers: ASTM F436
    a. Finish: Hot dipped galvanized
10. Anchor Rods: ASTM F1554; Grade 36.
11. Threaded Rods: ASTM A36
    a. Finish: Hot dipped galvanized
12. Welding Materials: AWS D1.1; type required for materials being welded.
13. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide.
14. Touch-Up Primer for Galvanized Surfaces: Zinc rich type.

B. STAINLESS STEEL
1. Bars and Shapes: ASTM A276; Type 316.
2. Tubing: ASTM A269; Type 316.
3. Pipe: ASTM A312, seamless; Type 316.
4. Plate, Sheet and Strip: ASTM A240 or ASTM A666; Type 316.
5. Bolts: ASTM F593, Type 316
6. Nuts: ASTM F594, Type 316
7. Washers: ASTM A240, Type 316
8. Welding Materials: AWS D1.6; type required for materials being welded.

C. ALUMINUM
1. Extruded Aluminum: ASTM B221 Alloy 6063, Temper T5
2. Sheet Aluminum: ASTM B209, Alloy 6063, Temper T5
3. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210 Alloy 6063, Temper T6.
4. Aluminum-Alloy Bars: ASTM B211, Alloy 6063, Temper T6.
5. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
6. Aluminum-Alloy Die Castings: ASTM B85, Alloy as required to suit application.
7. Bolts, Nuts, and Washers: Stainless steel.
8. Welding Materials: AWS D1.1; type required for materials being welded.
9. Factory Finish coatings to conform to AAMA 2603. Comply with AA DAF-45.

2.2 FABRICATION

A. Fit and shop assemble in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by continuous welds.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FINISHES

A. Refer to Section 09 90 00, Painting and Coating

2.4 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means erector accepts existing conditions.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, to appropriate sections.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Field weld components indicated on drawings.

D. Perform field welding in accordance with AWS D1.1, D1.2 or D1.6 as required.

E. Obtain Engineer approval prior to site cutting or making adjustments not scheduled.

F. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

G. Apply finishes as required for metal material to any surfaces to be in contact with concrete.

H. Grind exposed joints on handrails flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

I. Install ladders, guardrails, or other fabrications meant for safety according to manufacturer's requirements and OSHA standards.

3.4 ERECTION TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/8 inch.

3.5 FIELD QUALITY CONTROL

A. Welding: Inspect welds in accordance with AWS D1.1, D1.2 or D1.6 as required.

END OF SECTION

SECTION 06 10 53
MISCELLANEOUS ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Wood blocking, furring, grounds and nailers.
      a. Provide solid wood blocking at the following locations including, but not limited to, pencil sharpeners, door stops, grab bars, wall mounted toilet accessories, coat racks, 2 rows each at base and upper cabinets and casework, TV brackets, toilet partitions, mirrors, markerboards, and other wall mounted fixtures.
   2. Plywood backing panels.

B. Related Sections include the following:
   1. Division 6 Section "Interior Architectural Woodwork" for nonstructural carpentry items exposed to view and not specified in another Section.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NHLA: National Hardwood Lumber Association.
   2. NLGA: National Lumber Grades Authority.
   3. SPIB: The Southern Pine Inspection Bureau.
   4. WCLIB: West Coast Lumber Inspection Bureau.
   5. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
   1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all miscellaneous carpentry, unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).
1. Use treatment that does not promote corrosion of metal fasteners.
2. Use Interior Type A, unless otherwise indicated.

B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

D. Application: Treat all miscellaneous carpentry, unless otherwise indicated.

2.4 DIMENSION LUMBER FRAMING

A. Maximum Moisture Content: 19 percent.

B. Framing: Construction, Stud, or No. 3 grade and the following species:
1. Hem-fir; WCLIB or WWPA.

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
1. Blocking.
2. Nailers.
3. Furring.
4. Grounds.

B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber with 19 percent maximum moisture content and the following species:
1. Hem-fir; WCLIB, or WWPA.

C. For exposed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
   1. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.

D. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:
   1. Hem-fir or hem-fir (north), Standard or 3 Common grade; NLGA, WCLIB, or WWPA.

E. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.6 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
   1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.8 METAL FRAMING ANCHORS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Simpson Strong-Tie Co., Inc.

B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

2.9 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

D. Do not splice structural members between supports, unless otherwise indicated.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
   3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
   4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

J. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD GROUND, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal size furring horizontally at 24 inches o.c.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 06 16 00
FRAMING AND SHEATHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Framing, plates, and sheathing for all construction project.

B. Roof and ceiling framing.

C. Roof sheathing.

D. Preservative treatment of wood.

E. Miscellaneous framing, plates, blocking and sheathing.

1.2 REFERENCES

A. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.

B. APA: American Plywood Association.

C. AWPA (American Wood Preservers Association) C1 - All Timber Products Preservative Treatment by Pressure Process.

D. NFPA: National Forest Products Association.

E. WCLIB:West Coast Lumber Inspection Bureau.

F. WWPA: Western Wood Products Association.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide technical data on wood preservative treated materials.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:
   1. Lumber Grading Agency: Certified by ALSC.
   2. Plywood Grading Agency: Certified by APA.

PART 2 PRODUCTS

2.1 LUMBER MATERIALS

A. Lumber Grading Rules: WWPA, WCLIB.

B. Miscellaneous Plates and Framing: Douglas Fir-Larch species, No. 2 or better, 19 percent maximum moisture content, pressure preservative treat all wood members in contact with concrete or masonry.

2.2 SHEATHING MATERIALS

A. Roof Sheathing: APA Rated Sheathing; Veneer C-D; Exposure Durability 1; unsanded.

B. Wall Sheathing: APA Rated Sheathing; Veneer C-D; Exposure Durability 1; Unsanded

C. Ceiling Sheathing: Veneer A-C; Exposure Durability 1; Sanded

2.3 ACCESSORIES

A. Fasteners and Anchors:
   1. Fasteners: ASTM A153/A153M, Hot-dipped galvanized steel.
   2. Nails and Stables: ASTM F1667.
   3. Adhesives: ASTM 3498, APA-AFG-01 for plywood to wood framing connections.
   4. Drywall Screws: Bugle head, hardened steel, power driven, length 2.5 times thickness of sheathing.

B. Structural Framing Connectors: Hot dipped galvanized steel, sized to suit framing conditions, as shown on drawings.

C. Building Paper: ASTM D226; Type I, No. 15 unperforated asphalt felt.

2.4 FACTORY WOOD TREATMENT

A. Wood Preservative (Pressure Treatment): American Wood Preservers Bureau Standard LP-2 using Wohman CCA preservative with 25 lbs. per cubic foot retainage.

PART 3 EXECUTION

3.1 FRAMING

A. Set members level and plumb, in correct position.

B. Fasten framing in accordance with current IBC code.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Place horizontal members, crown side up.

E. Construct framing members full length without splices.

F. Coordinate installation of roof trusses.

3.2 SHEATHING

A. Fasten sheathing in accordance with current IBC code and as indicated in the drawings.

B. Secure roof and floor sheathing perpendicular to framing members with ends staggered and sheet ends over firm bearing.

C. Use sheathing clips between sheets between roof framing members. Offset end joints 4'-0" in alternate rows. Install solid edge blocking between sheets where indicated in the drawings.

D. Secure wall sheathing with long dimension parallel to wall studs, with ends over firm bearing.

E. Secure ceiling sheathing to trusses with adhesive and galvanized nails at 12 inches O.C. along framing members. Set nails flush with sheathing.

F. Place building paper horizontally over wall sheathing; weather lap edges and ends.

3.3 TOLERANCES

A. Framing Members: 1/8 inch from true position, maximum.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 06 17 53
SHOP-FABRICATED WOOD TRUSSES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shop fabricated wood trusses for roof framing.

B. Bridging, bracing, and anchorage.

1.2 REFERENCES

A. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.

B. ASTM A446 - Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural Quality.

C. NFPA: National Forest Products Association.

D. TPI (Truss Plate Institute) HIB-91 - Handling, Installing and Bracing Wood Trusses.

E. TPI (Truss Plate Institute) TPI-85 - Metal Plate Connected Wood Trusses.

F. TPI (Truss Plate Institute) QST-88 - Metal Plate Connected Wood Trusses.

G. WCLIB: West Coast Lumber Inspection Bureau.

H. WWPA: Western Wood Products Association.

1.3 SYSTEM DESCRIPTION

A. Design roof snow load: As specified in the structural Drawings design criteria with deflection limited to 1/360.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Indicate sizes and spacing of trusses, loads and truss cambers, and framed openings.

C. Design Calculations: Stamped by Licensed Structural Engineer.

D. Product Data: Provide truss configurations, bearing and anchor details, bridging and bracing, and certifications.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:
   1. Lumber Grading Agency: Certified by ALSC.
   2. Plywood Grading Agency: Certified by APA.

B. Truss Design, Fabrication, and Installation: In accordance with Truss Plate Institute HIB-91, including Supplement, TPI-85 including Supplement, QST-88.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Design trusses under direct supervision of a Professional Structural Engineer experienced in design of this Work.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable code for loads, seismic zoning, and other governing load criteria.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01 60 00 – Product Requirements.

B. Handle and erect trusses in accordance with TPI HET-80.

C. Store trusses in vertical position resting on bearing ends.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated.

PART 2 PRODUCTS

2.1 WOOD TRUSSES

A. All press plate wood trusses shall be manufactured in accordance with the requirements of the Truss Plate Institute.

2.2 MATERIALS

A. Lumber Grading Rules: WCLIB or WWPA.

B. Wood Members: Single top and bottom chord, Douglas Fir-Larch species, No. 2 or better, 19 percent maximum and 7 percent minimum moisture content. Finger scarfing not permitted.

C. Steel Connectors: ASTM A446 steel, Grade B galvanized; die stamped with integral teeth.

D. Truss Bridging: 1/2" X 24" Structural I Plywood. Ends shall be overlapped 12" minimum.

2.3 ACCESSORIES

A. Wood Blocking, Plating, Support Members, Framing for Openings: Douglas Fir-Larch species, No. 2 or better, 19 percent maximum and 7 percent minimum moisture content.

B. Fasteners: Electro-galvanized, Hot dip galvanized, unfinished steel, type to suit application.

C. Bearing Plates: Hot dip galvanized.

2.4 FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Brace wood trusses in accordance with TPI BWT-76.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that supports and openings are ready to receive trusses.

3.2 PREPARATION

A. Coordinate placement of bearing items.

3.3 ERECTION

A. Erect press plate wood trusses in accordance with the requirements of the Truss Plate Institute.

B. Install trusses in accordance with manufacturer's instructions.

C. Set members level and plumb, in correct position.

D. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.

E. Do not field cut or alter structural members without approval of a Licensed Structural Engineer in the state where the project is located.

F. Place headers and supports to frame openings required.

G. Coordinate placement of decking with work of this section.

H. After erection, touch-up primed or galvanized surfaces with primer consistent with shop coat or zinc primer.

3.4 TOLERANCES

A. Framing Members: 1/2 inch maximum, from true position.

END OF SECTION

SECTION 06 64 00
PLASTIC PANELING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Plastic sheet wall and ceiling paneling.
   2. Factory-laminated wall and ceiling plastic sheet paneling.

B. Related Requirements:
   1. Section 06 10 53 – Miscellaneous Rough Carpentry for wood furring for installing plastic paneling.

1.2 SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling in manufacturer's standard sizes.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Experience completing a minimum five projects of similar size, type, and complexity. Workers employed on this Project competent in techniques required by manufacturer for installation indicated.

B. Testing Agency: Acceptable to authorities having jurisdiction and FM Approvals.

C. Surface-Burning Characteristics: Determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction.

D. FM 4880 approved.

E. Meets USDA/FSIS requirements.

F. UL 2818 GREENGUARD GOLD certified.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace defective panels and components that fail in materials or workmanship under normal conditions of use within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Exposed fibers.
      b. Rust.
      c. Rot.
      d. Corrosion.
      e. Structural surface cracks.
      f. Painting or refinishing required with normal pigmentation and UV degradation excepted.
   2. Warranty Period - Glass-Fiber-Reinforced Plastic Paneling: 1 year from date of Substantial Completion.
   3. Warranty Period - Factory-Laminated Glass-Fiber-Reinforced Plastic Paneling: 1 year from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 GENERAL:

A. Wall and ceiling materials will comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions will not exceed 16.5 mcg/cu. m or 13.5 ppb, whichever is less.

B. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.
   1. Class: C
   2. Flame-Spread Index: 200 or less.
   3. Smoke-Developed Index: 450 or less.

C. Where required by building occupancy and intended use, panels will be USDA accepted for incidental food contact.

2.3 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crane Composites, Inc.; GLASBORD Series or comparable product by one of the following:
    a. Glasteel.
    b. Marlite.
    c. Newcourt, Inc.
    d. Nudo Products, Inc.
    e. Parkland Plastics, Inc.
    f. Or approved equal.
2. Nominal Thickness: Not less than 0.070 inch.
3. Wall Panel Size: 4 by 8 ft. or as indicated on Drawings.
4. Surface Finish: Smooth.
5. Color: White

B. Unreinforced Polypropylene Paneling: Solid polypropylene panels made from no less than 80 percent recycled material.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    a. Parkland Plastics, Inc.
    b. Or approved equal.
2. Nominal Thickness: Not less than 0.06 inch.
3. Surface Finish: Smooth.
4. Color: White.

C. Unreinforced PVC Paneling: Solid polyvinyl chloride panels.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    a. Acoustic Ceiling Products, LLC.
    b. Or approved equal.
2. Nominal Thickness: Not less than 0.03 inch.
3. Surface Finish: Smooth.
4. Color: White.

D. Biobased Plastic Paneling: Solid paneling made from biobased modified polyactide resin with flame retardant and integral color.
1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    a. Alpar Architectural Products, LLC.
    b. Or approved equal.
2. Nominal Thickness: Not less than 0.04 inch.
3. Surface Finish: Suede texture.
4. Color: White.

2.4 FACTORY-LAMINATED PLASTIC SHEET PANELING

A. Factory-Laminated Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319, laminated to plywood, oriented strand board, gypsum board, high-impact gypsum board, or water-resistant gypsum board.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Crane Composites, Inc.; GLASBORD Wall Panel (FX Class A, PIF Class C) or comparable product by one of the following:

    a. Arcoplast Inc.
    b. Citadel Architectural Products, Inc.
    c. Glasteel.
    d. Newcourt, Inc.
    e. Nudo Products, Inc.
    f. Or approved equal.

2. Glass-Fiber-Reinforced Plastic Panel Nominal Thickness: Not less than 0.075 inch.
3. Surface Finish: Smooth.
4. Color: White.
5. Plywood: DOC PS 1, Exterior B-C, 1/2 inch thick.
6. Oriented Strand Board: DOC PS 2, Exposure 1, 1/2 inch thick.
7. Gypsum Board: ASTM C1396, Regular, 1/2 inch, Type X, 5/8 inch.
8. High-Impact Gypsum Board: ASTM C1396, 5/8 inch, with Type X core, and 0.020-inch minimum plastic film laminated to back side for greater resistance to penetration (impact resistance).
9. Water-Resistant Gypsum Board: ASTM C1396 or ASTM C1178, 5/8 inch, Type X, with water-resistant core and surfaces.

B. Factory-Laminated PVC Paneling: Solid polyvinyl chloride sheet, laminated to plywood, oriented strand board, gypsum board, high-impact gypsum board, or water-resistant gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Newcourt, Inc.
    b. Or approved equal.

2. Nominal Thickness: Not less than 0.015 inch.
3. Surface Finish: Smooth
4. Color: White
5. Plywood: DOC PS 1, Exterior B-C, 1/2 inch thick.
6. Oriented Strand Board: DOC PS 2, Exposure 1, 1/2 inch thick.
7. Gypsum Board: ASTM C1396, Regular, 1/2 inch, Type X, 5/8 inch.
8. High-Impact Gypsum Board: ASTM C1396, 5/8 inch, with Type X core, and 0.020-inch plastic film laminated to back side for greater resistance to penetration (impact resistance).
9. Water-Resistant Gypsum Board: ASTM C1396 or ASTM C1178, 5/8 inch, Type X, with water-resistant core and surfaces.

2.5 ACCESSORIES

A. Trim Accessories: Manufacturer's standard designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
   1. Color: Match panels.

B. Moldings: As indicated by manufacturer's product designations.

C. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

D. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

E. Adhesive: As recommended by plastic paneling manufacturer.
   1. Adhesive will comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions will not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

F. Sealant: Mildew-resistant, single-component, neutral-curing or acid-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 90 00 – Joint Protection.
   1. Sealant will comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions will not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

G. Color Caulk: Color Sil by Color Rite, 100 percent silicone-based colored caulk, available in sanded and linen/satin finish or approved equal.
   1. Color: Match panels and trim.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. Corners: Plumb and straight.
   2. Surfaces: Smooth, sound, and uniform.
   3. Nails or Screw Fasteners: Countersunk.
   4. Joints and Cracks: Filled flush and smooth with adjoining surfaces.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove surface coverings, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Ensure that all HVAC, electrical, plumbing, and similar work above the ceiling level has been completed.

E. Condition panels by unpacking and placing in installation space before installation in accordance with manufacturer's written recommendations.

F. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls and ceilings not less than half the width of full panels.
   1. Mark plumb lines on substrate at trim accessory or panel joint locations for accurate installation.
   2. Locate trim accessories or panel joints to allow clearance at panel edges in accordance with manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling in accordance with manufacturer's written instructions.
   1. Do all cutting with carbide-tipped saw blades or drill bits, or cut with snips.
   2. Install panels plumb, level, square, flat, and in proper alignment.
   3. Install panels to be water resistant and washable.
   4. Install panels with manufacturer's recommended gap for panel field and corner joints.

B. Install panels in a full spread of adhesive.

C. Install factory-laminated panels using concealed mounting splines in panel joints.

D. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.

E. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

F. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

G. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

SECTION 07 11 13
BITUMINOUS DAMP PROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes cold-applied, emulsified asphalt damp proofing applied to the following surfaces:
   1. Exterior, below-grade surfaces of concrete foundation walls.
   2. Back side of concrete and masonry retaining walls, below grade. List below only products that the reader might expect to find in this Section but are specified elsewhere.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

B. Material Certificates: For each product, signed by manufacturers.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primary damp proofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit asphalt damp proofing to be performed according to manufacturers' written instructions.

B. Delete below if no enclosed or interior applications are included in Project.

C. Ventilation: Provide adequate ventilation during application of damp proofing in enclosed spaces. Maintain ventilation until damp proofing has thoroughly cured.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Retain above for nonproprietary or below for semi proprietary specification. Refer to Division 1 Section "Product Requirements."

1. Cold-Applied, Emulsified-Asphalt Damp proofing:
    a. Karnak Corporation.
    b. Koppers Industries, Inc.
    c. Meadows, W. R., Inc.
    d. Sonneborn, Div. of ChemRex, Inc.
    e. Tamms Industries.
2. Protection Course, Asphalt-Board Type:
    a. Grace, W. R. & Co.; Construction Products Div.
    b. Meadows, W. R., Inc.
    c. Sonneborn, Div. of ChemRex, Inc.

2.2 BITUMINOUS DAMPPROOFING

A. Odor Elimination: For interior and concealed-in-wall uses other than exterior face of inner wythe of cavity walls, provide damp proofing material warranted by manufacturer to be substantially odor free after drying for 24 hours under normal conditions.

B. Cold-Applied, Emulsified-Asphalt Damp proofing:
1. Trowel Coats: ASTM D 1227, Type II, Class 1.
2. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
3. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.3 MISCELLANEOUS MATERIALS

A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.

B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

C. Protection Course, Asphalt-Board Type: Premolded, 1/8-inch thick, multi-ply, semirigid board consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt and faced on 1 side with polyethylene film. Paragraph below describes Dow Chemical Company's "Protection Board" and "Protection Board II," Owens Corning's "Fan Fold," and Tenneco Building Products' "Amocor-PB4."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
   1. Begin damp proofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with damp proofing. Prevent damp proofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of damp proofing.
   1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated.
   2. Allow each coat of damp proofing to cure 24 hours before applying subsequent coats.

B. Apply damp proofing to footings and foundation walls whether indicated or not.
   1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing.
   2. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
   3. Normally retain subparagraph below. Corners are generally the weakest link in damp proofing protection.
   4. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch wide strip of asphalt-coated glass fabric in a heavy coat of damp proofing. Damp proofing coat required for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. On Concrete Foundations: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat, one fibered brush or spray coat at not less than 3 gal./100 sq. ft., or one trowel coat at not less than 4 gal./100 sq. ft.

B. On Backs of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft.

C. On Backs of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal./100 sq. ft.

D. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft.

3.5 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured damp proofing. Comply with damp proofing material manufacturer's written recommendations for attaching protection course. Support protection course with spot application of trowel-grade mastic where not otherwise indicated.

3.6 CLEANING

A. Remove damp proofing materials from surfaces not intended to receive damp proofing.

END OF SECTION

SECTION 07 19 00
WATER REPELLENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes clear water-repellent coatings for the following vertical and nontraffic horizontal surfaces:
   1. Concrete unit masonry (unpainted and unglazed).

B. Related Sections include the following:
   1. Division 3 Sections for concrete work including floor sealers and curing agents.
   2. Division 4 Sections for concrete unit masonry.
   3. Division 7 Section "Joint Sealants" for joint sealants.
   4. Division 9 Section "Painting" for paints and coatings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide water repellents with the following properties based on testing manufacturer's standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.
   1. Absorption: Minimum 98 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
      a. Concrete Unit Masonry: ASTM C 140.
   2. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
   3. Water Penetration and Leakage through Masonry: Maximum 98 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.
   4. Durability: Maximum 5 percent loss of water repellency after 2500 hours of weathering in comparison to specimens before weathering, per ASTM G 53.
   5. Permeability: Minimum 80 percent breathable in comparison of treated and untreated specimens, per ASTM D 1653.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's specifications, surface preparation and application instructions, recommendations for water repellents for each surface to be treated, and protection and cleaning instructions. Include data substantiating that

materials are recommended by manufacturer for applications indicated and comply with requirements.

B. Samples: Of each substrate indicated to receive water repellent, 12 inches square, with specified repellent treatment applied to half of each sample.

C. Applicator Certificates: Signed by manufacturer certifying that the applicator complies with requirements.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who employs only persons trained and approved by water repellent manufacturer for application of manufacturer's products.

1.6 TEST PANELS

A. Field Samples: Select multiple representative surfaces for each substrate to receive water repellents. Apply water repellent to each substrate, with either partial or full coverage as directed and in accordance with provisions in this Section. Comply with application requirements of this Section.
   1. Obtain Architect's approval of field samples before applying water repellents.
   2. Maintain field samples during construction in an undisturbed condition as a standard for judging the completed Work.

B. Clean test panel area following substrate manufacture=s guidelines and recommended products for cleaning.

C. After substrate has dried, rilem tube testing shall be done by manufactures representative, to determine coverage rates.

D. Before full-scale application, review manufacturer's product data sheets to determine the suitability of each product for the specific surfaces. Apply each water repellent to test panels to determine number of applications, coverage rates, compatibility, effectiveness, surface preparation, application procedures, and desired results.

E. Apply water repellents to test panels in accordance with manufacturer's written instructions. Allow 48 hours or until test panels are thoroughly dry before evaluating final appearance and results. A final rilem tube test shall be done to determine if desired finish has been accomplished. Do not begin full-scale application until test panels are inspected and approved by the Architect and the Manufacturer.

F. Test Panel Requirements:
   1. Size: Minimum 4 feet by 4 feet each.
   2. Locations: As determined by the Architect.
   3. Number: As required to completely test each water repellent with each type of substrate to be protected.

1.7 PROJECT CONDITIONS

A. Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions, except with written instruction of manufacturer:
   1. Ambient temperature is less than 40 deg F.
   2. Concrete surfaces and mortar have cured for less than 28 days.
   3. Rain or temperatures below 40 deg F are predicted within 24 hours.
   4. Application is earlier than 24 hours after surfaces have been wet.
   5. Substrate is frozen or surface temperature is less than 40 deg F.
   6. Windy condition exists that may cause water repellent to be blown onto vegetation or surfaces not intended to be coated.

1.8 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: Submit a written warranty, executed by the applicator and water repellent manufacturer, covering materials and labor, agreeing to repair or replace materials that fail to provide water repellency within the specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1/16 inch wide, fire, vandalism, or abuse by maintenance equipment.
   1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Silicones: With more than 3.3 lb/gal VOCs.
      a. Weather Seal Blok-Guard & Graffiti Control; ProSoCo, Inc.

2.2 WATER REPELLENTS

A. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other

manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Silicone Sealer: Film-forming, polymerized, silicone-resin water repellent for dense substrates; solvent- or water-based solution containing not less than 3 and up to 5 percent solids by weight; complying with FS SS-W-110.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to repellent manufacturer's written instructions, to ensure surface is sufficiently dry.

B. Test for pH level, according to water repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.

C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.

D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

E. Test Application: Before performing water-repellent work, including bulk purchase and delivery of products, prepare a small application in an unobtrusive location that has been fully cleaned and in a manner approved by Architect to demonstrate the final effect (visual, physical, and chemical) of planned application. Proceed with work only after Architect approves test application or as otherwise directed.
1. Revisions of planned application, if any, as requested by Architect, will be by Change Order if they constitute a departure from requirements of Contract Documents at the time of contracting.

3.2 APPLICATION

A. Application rate shall be in accordance with manufacturer’s written recommendations and in accordance with proper coverage rates for warranty requirements.

B. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.
1. Precast Work: At Contractor's option, first application of water repellent on precast concrete units may be completed before installing units. Mask

sealant-bond surfaces to prevent water repellent from migrating onto joint surfaces.

C. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method to be used.

3.4 CLEANING

A. Protective Coverings: Remove protective coverings from adjacent surfaces and other protected areas.

B. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

3.5 EXTERIOR SCHEDULE

A. General: Provide the following systems for the various substrates, as indicated.

1. MASONRY SEALER (Concrete Masonry Units)

1st Coat: ProSoCo Sure Klean Weather Seal Blok-Guard and Graffiti Control

Apply one (1) uniform pinhole free, continuous flood coat from the bottom up, with a 6-8" run-down, at rate of 75-100 sq. ft. per gallon and in accordance with test application coverage rate. Test application rate shall govern where a discrepancy occurs.

Apply 2nd coat within 2 hours of the first coat or as soon as the first coat is dry to touch.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The work included in this section consists of furnishing and installing insulation in building interior and exterior walls and ceilings as shown on the Drawings and as specified herein.

B. Thermal resistivity or "R-value" represents the rate of heat flow through a homogeneous material exactly V thick and is expressed by the temperature difference in degrees F between the two exposed faces required to cause 1 BTU to flow through 1 square foot per hour at mean temperatures indicated.

C. Fire Performance Characteristics. Provide insulation with fire performance characteristics indicated per ASTM E 119, ASTM E84 and E136, as applicable, and which correspond to products listed in UL "Fire Resistance Directory" or "Building Materials Directory."

D. Masonry insulation is specified in Section 07 21 23 – Loose-Fill Insulation.

1.2 STANDARD

A. R-value definition shall be in accordance with ASTM C 177 or C 653.

1.3 SUBMITTALS

A. Submittals shall conform to the provisions of Section 01 33 00 – Submittal Procedures. Submit catalog cuts of materials proposed to be used.

1.4 DELIVERY, STORAGE AND HANDLING

A. Protect insulation during delivery and storage against moisture 0absorption or other damage. Material with broken wrappers or cartons will be rejected. Store above ground or floor in protected area under roof or tarps.

PART 2 PRODUCTS

2.1 INSULATION

A. GENERAL

1. Provide preformed units in sizes to fit applications indicated, selected from manufacturer’s standard thicknesses, widths, and lengths.

2. Ceiling insulation shall be fiberglass or rockwool conforming to Federal Specification HH-I-1030B and ASTM C764. Insulation thickness shall be sufficient to provide an R-value of 39. Wall insulation shall be R-19.
3. Expanded Polystyrene Board Insulation: ASTM C578, type as indicated blow; with 5-year aged R-values of 5.,4 and 5.0 and 40° F and 75° F (4.4° C and 23.9° C), respectively, and as follows:
    a. Dow Chemical or equal expanded polystyrene insulation boards; Styrofoam SM shall be 2" thick and shall extend 2'-0" (minimum) below the bottom of the floor slab where adjacent grade is at or below finish floor, 4-0" high in earth berms at all other locations. Perimeter insulation shall have Thermal resistance "R" of 5.00 per 1" of thickness.
4. Polyisocyanurate Board Insulation: Glass-fiber-reinforced polyisocyanurate closed-cell foam core and aluminum foil facing laminated to both sides; FS HH-I-1972/1, Class 2; aged R-values of 7.2 and 8.0 at 40° F and 75° F (4.4° C and 23.9° C), respectively, and as follows:
    a. Combustion Characteristics: Passes ASTM E136 test.
5. Loose Glass Fiber Insulation: Glass fibers processed to comply with ASTM C764 for type (method of application) indicated below; passing ASTM E136 for combustion characteristics; maximum flame spread and smoke developed values of 5 and 5, respectively and as follows:
    a. Type 1 for pneumatic application.
6. Combustion Characteristics: Unfaced materials passes ASTM E136 test.
    a. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50 respectively.
7. Polyethylene Vapor Retarder: 6-mil polyethylene film, with laboratory-tested vapor transmission rating of 0.2 perms, natural color. Provide at all exterior framed walls.
8. Adhesive for Bonding Insulation: Type as recommended by manufacturer.
9. Mechanical Anchors: Type and size recommended by insulation manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. GENERAL
1. Comply with insulation manufacturer's instructions for installation of insulation.
2. Support insulation units by adhesive or mechanical anchorage or both as applicable to location and conditions indicated.
    a. For cavity insulation supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified under Division 4, "Unit Masonry".

3. Ceiling Insulation. All ceilings shall be insulated with fiberglass batt ceiling insulation or blown-in ceiling insulation in accordance with the manufacturer's instructions to the depth required to give an R-value of 38. Care shall be taken during insulation to provide space for ventilation requirements along eaves of building.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 21 23
LOOSE-FILL INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes granular insulation in cells of concrete masonry unit walls.

1.2 REFERENCES

A. ASTM International:
   1. ASTM C516 - Standard Specification for Vermiculite Loose Fill Thermal Insulation.
   2. ASTM C549 - Standard Specification for Perlite Loose Fill Insulation.
   3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   4. ASTM E970 - Standard Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source.

1.3 SUBMITTALS

A. Submittals shall conform to the provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit data on product characteristics, performance criteria, and limitations.

C. Manufacturer's Installation Instructions: Submit procedure for preparation and installation.

PART 2 PRODUCTS

2.1 LOOSE-FILL INSULATION

A. MATERIALS
   1. Granular Insulation: ASTM C516, Type II; vermiculite type, water repellent, fire resistant, flame/smoke contribution of 0/0 in accordance with ASTM E84.
   2. Granular Insulation: ASTM C549, perlite type, water repellent, fire resistant, flame/smoke contribution of 0/0 in accordance with ASTM E84.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrate, adjacent materials, and insulation are dry and ready to receive insulation.

B. Verify spaces are free of mortar to allow free flow of insulation.

3.2 PREPARATION

A. Verify holes and openings have been sealed to prevent escape of insulation.

3.3 INSTALLATION

A. Place after masonry wall has sufficiently dried and attained optimum moisture content. Place prior to covering cores with bond beams or lintels.

B. Place as wall is erected. Completely fill spaces.

C. Place in lifts. Do not exceed 4 feet pouring height.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

A. Place temporary signs in rooms facing insulated walls warning workers to use caution to prevent loss of insulation when cutting into walls.

END OF SECTION

SECTION 07 42 93
SOFFIT PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Scope of Work
   1. Furnish and Install Performed Metal Soffit System with continuous interlocking panels connections.
   2. Provide all necessary accessories, edge trim, moldings, corners, and attachment clips as required.

1.2 SECTION INCLUDES

A. Performed aluminum soffit system.

1.3 REFERENCES

A. ASTM D -1400-87, D -1005-84 - Kynar 500 ® or Hylar 5000 ® Finish tested by PPG Industries for: Dry Film Thickness (Nominal):

B. ASTM B 209 – Standard Specification for Aluminum and Aluminum – Alloy Sheet and Plate.

1.4 PERFORMANCE REQUIREMENTS:

A. Design Requirements:
   1. System shall meet performance criteria per manufacture.

B. Wind Loading: Design and size components to withstand dead and live loads cause by wind pressures as follows:
   1. Positive pressure: 120 psf normal to panel.
   2. Negative pressure: 120 psf normal to panel.

C. All panels shall be fastened to the framing members with concealed anchor clips designed to allow for thermal movement of the panels.

D. All trim and flashing components shall be fabricated in lengths of 12’-0” to minimize joint details.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures. Alternates to this specification must be submitted ten (10) days prior to bid date.

B. Product Data: Submit manufacturer's current product specifications and installation instructions.

C. Samples: Submit two samples of each type of metal panel required, not less than 12 inches, and illustrating finished panel profile, color, sheen, and texture.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
   1. All panels are to factory formed and packaged per job requirements.
   2. Manufacturer shall have a minimum of five (5) years experience in the factory fabrication of metal soffit panels.

B. Installer: Company specializing in the type of work requires for this project, with not less than 2 years of documented experience.

1.7 DELIVERY, STORAGE AND HANDLING

A. Comply with provisions of Section 01 60 00 – Product Requirements.

B. Do not deliver materials of this section to project site until suitable facilities for storage and protection are available.

C. Protect materials from damage during transit and at project site. Store under cover but sloped to provide positive drainage. Do not expose materials with strippable protective film to direct sunlight or extreme heat.

1.8 WARRANTY

A. Comply with provisions of Section 01 77 00 – Closeout Procedures.

B. Submit manufacturer's standard warranty. The fluoropolymer Kyner 500® and Hylar 5000® finishes carry a twenty (20) year limited warranty against chipping, cracking, peeling, chalking, and fading.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aluminum Sheet: ASTM B 209 Prefinish as specified under panel type.

2.2 FINISHES

A. Corrosion inhibiting primer and baked on acrylic top coat.

2.3 PANEL SYSTEMS

A. Preformed metal soffits shall be fabricated with .032 Aluminum. Panels shall be smooth, 18" wide and standard length of 12'-0" or as required for job conditions.

B. Provide panels with ventilated panel at every third panel installed for positive ventilation unless noted otherwise on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Installer shall examine all substrates on which panel system and accessories are to applied.
   1. If surfaces are not suitable for application of panel system, installer shall notify the engineer in writing.
   2. Installation shall not proceed until surface is acceptable to all parties.

3.2 PREPARATION

A. Confirm all furring and support framing is in place and plumb or level prior to installation.

3.3 INSTALLATION

A. Install metal panels and accessories in strict accordance with manufacturer instructions.

B. Protect surfaces from contact with cementitious materials and other dissimilar metals with bituminous paint or other coatings.

C. Fasten panels to structural support with fasteners provided or approved by panel manufacturer. Install panels plumb, level, and true to line.

D. Fully interlock panels or nest with adjacent panels.

E. Remove protective masking from panels immediately after each panel is installed.

F. Care should be taken during handling of panels to prevent bending, twisting, abrasion, scratching, denting, etc.

G. Workmanship to comply with standards established by the Architectural Sheet Metal Community.

3.4 ADJUSTING AND CLEANING

A. Touch up minor abrasions and exposed fasteners with matching paint provided by panel manufacturer. Remove and replace panels that cannot be satisfactorily touched up.

B. Leave installed work clean, free from grease, finger marks, and stains. Remove all protective masking from material immediately after installation of product.

C. Upon completion of installation, remove scraps and debris from project site.

3.5 PROTECTION

A. Provide protection as required to assure that completed work of this section will be without damage or deterioration at date of substantial completion.

B. Safety clothing, equipment and precautions must be utilized according to safety standards.

END OF SECTION

SECTION 07 61 00
SHEET METAL ROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Architectural standing seam metal roofing.
2. Structural supports.
3. Underlayment.
4. Eave protection.
5. Metal facias, flashings, and trim.
6. Snow guards.

1.2 REFERENCES

A. American Iron and Steel Institute:
1. AISI SG-973 - Cold-Formed Steel Design Manual.

B. ASTM International:
1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products.
3. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
4. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
5. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
6. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
7. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.

C. National Roofing Contractors Association:
1. NRCA - The NRCA Roofing and Waterproofing Manual.

D. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - Architectural Sheet Metal Manual.

E. Underwriters Laboratories Inc.:
   1. UL 580 - Tests for Uplift Resistance of Roof Assemblies.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures.

B. Product Data:
   1. Submit data on metal types, finishes, and characteristics.
   2. Submit color charts for finish selection.

C. Samples:
   1. Submit two samples 3" x 3" inch in size illustrating metal finish color.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA Architectural Sheet Metal Manual and The NRCA Roofing and Waterproofing Manual.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials causing discoloration or staining.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 COORDINATION

A. Section 01 31 00 – Project Management and Coordination.

B. Coordinate with Work of Section 03 10 00 – Concrete Forming and Accessories and Section 04 22 00 - Concrete Unit Masonry for installing recessed flashing reglets.

C. Coordinate with Work of Section 06 16 00 – Framing and Sheathing for connecting structural supports to building structural frame.

1.9 WARRANTY

A. Section 01 77 00 – Closeout Procedures: Requirements for warranties.

B. Provide two-year warranty under provisions of Section 01 77 00 – Closeout Procedures.

C. Warranty: Include coverage for degradation of metal finish, water tightness, and integrity of seals.

D. Furnish 20 year manufacturer warranty for sheet metal roofing against corrosion, and water penetration.

E. Furnish 20 year manufacturer warranty for metal finish against fading, chipping, chalking, and blistering.

PART 2 PRODUCTS

2.1 MANUFACTURED SHEET METAL ROOFING

A. Manufacturers:
   1. Fabral
   2. Substitutions: Section 01 60 00 – Product Requirements.

B. Standing Seam Metal Roofing: Factory formed metal roofing panel system with concealed fasteners.
   1. Panel Materials: Pre-finished steel sheet, ASTM A924, G90; 24 gage core steel.
   2. Panel Width: Nominal 12-18 inches.
   3. Panel Profile: Flat.
   4. Seam Type: Sanding seam snap interlocked.
   5. Seam Height: 1 inches.
   6. Color: As selected.

2.2 SHEET METAL MATERIALS

A. Pre-Finished Galvanized Steel Sheet: ASTM A755/A755M coil coated.
   1. Base Metal: ASTM A653/A653M; G90 zinc coating.
   2. Exposed Finish: Acrylic coating.
   3. Unexposed Finish: Manufacturer’s standard coating.

2.3 ACCESSORIES

A. Fasteners: Same material and finish as roofing metal, with soft neoprene washers where exposed.

B. Underlayment: ASTM D226, organic roofing felt, Type II, Number 30.

C. Sealant: Polyurethane type, 2 manufactured by Sika Corporation.

D. Eave Protection Sheet: Rubberized asphalt bonded to sheet polyethylene, 40 mil total thickness, with strippable treated release paper; Ice and Water Shield manufactured by Grace.

E. Snow Guard: Per Manufacturer's recommendation of same color as roofing material and approved by engineer.

2.4 FABRICATION

A. Form sections shape as indicated on Drawings, accurate in size, square, and free from distortion or defects.

B. Fabricate facia, trim, flashing, and other metal components from same material as metal roof panels. Provide exposed metal surfaces with same finish as exposed face of metal roof panels.

C. Fabricate starter strips of same material as sheet, continuous, to interlock with sheet.

D. Form pieces in longest practical lengths.

E. Hem exposed edges on underside 1/2 inch; miter and seam corners.

F. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

H. Fabricate flashings to allow toe to extend 4 inches over roofing. Return and brake edges.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 – Project Management and Coordination: Verification of existing conditions before starting work.

B. Wood and Metal Deck Substrate:
   1. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves, or projections, and properly sloped to drains valleys eaves.
   2. Verify deck is dry and free of snow and ice. Verify substrate joints are solidly supported and fastened.

C. Structural Framing Substrate:
   1. Verify primary and secondary framing members are installed and fastened, properly aligned and sloped to eaves.
   2. Verify damaged shop coatings are repaired with touch up paint.

D. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets are in place, and nailing strips located.

E. Verify roofing termination and base flashings are in place, sealed, and secure.

F. Verify insulation is installed and ready for roof application.

3.2 PREPARATION

A. Wood and Metal Deck Substrate:
   1. Broom clean deck surfaces under eave protection and underlayment.

3.3 INSTALLATION - EAVE PROTECTION

A. Apply eave protection sheet over deck flange of eave edge flashings.

B. Extend eave protection sheet minimum 2 feet upslope beyond interior face of exterior wall.

3.4 INSTALLATION - UNDERLAYMENT

A. Apply underlayment over entire roof area in single layer fastened to substrate.
   1. Install underlayment laid perpendicular to slope.
   2. Weather lap edges 2 inches and nail in place.
   3. Stagger end joints minimum 24 inches.

3.5 INSTALLATION - LAPPED SEAM METAL ROOFING

A. Conform to NRCA details.

B. Install roofing panels with long dimension perpendicular to eaves.

C. Install roofing panels beginning at eaves. Weather lap ends minimum 6 inches.

D. Align transverse lapped joints of roofing sheets.

E. Terminate roofing panels with sheet metal trim and flashing for watertight installation. Close and conceal openings between roofing panels, panel seams, and roof substrate.

F. Seal metal joints watertight.

3.6 INSTALLATION - SOFFIT PANELS

A. Install perimeter trim, level and aligned perpendicular with facia.

B. Install soffit panels to form flat, flush surface.

C. Fit soffit panels in single length between perimeter trim. Secure panels to soffit framing.

D. Install perforated soffit panels alternating with solid panels.

E. Adjust panels for uniform joints.

3.7 INSTALLATION - FLASHING

A. Install reglets in accordance with Section 04 22 00 – Concrete Unit Masonry.

B. Conform to NRCA details.

C. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.

D. Secure flashing exposed edges with continuous cleats maximum 24 inches on center.

E. Apply plastic cement compound between metal flashings and felt flashings.

F. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

G. Seal metal joints watertight.

3.8 INSTALLATION - SNOW GUARDS

A. Install snow guards in accordance with manufacturer's instructions.

B. Install snow guards in continuous line, 12 inches up slope of exterior wall.

C. Install one additional line of snow guards for every 15 feet measured along roof slope.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 77 00 – Closeout Procedures: Protecting installed construction.

B. Do not permit traffic over unprotected roof surface.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Prefinished Metal Flashing and Trim.

1.2 WORK INCLUDED

A. Coping and cap flashings.

B. Fascia and roof flashings.

1.3 REFERENCES

A. ASTM A924 – Prefinished Steel Sheet.

B. NAAMM - Metal Finishes Handbook.

C. NRCA (National Roofing Contractors Association) - Roofing Manual.

D. SMACNA - Architectural Sheet Metal Manual.

1.4 SYSTEM DESCRIPTION

A. Work of this Section is to physically protect base flashings, from damage that would permit water leakage to building interior.

1.5 QUALITY ASSURANCE

A. Applicator: Company specializing in sheet metal flashing work with three years' minimum experience.

1.6 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 01 33 00 – Submittal Procedures.

B. Submit manufacturer's installation instructions under provisions of Section 01 33 00 – Submittal Procedures.

C. Submit color samples 15 days prior to ordering material to allow Owner and/or Engineer to select color.

1.7 STORAGE AND HANDLING

A. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation.

B. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

A. Prefinished sheet Steel: ASTM A924, G90; 26 gage core steel, color to match roof or siding.

2.2 ACCESSORIES

A. Fastener: Prefinished steel with soft neoprene washers at exposed fasteners. Finish exposed fasteners same as flashing metal.

B. Underlayment: ASTM D266; No. 30 asphalt saturated roofing felt.

C. Protective Backing Paint: Zinc chromate alkyd.

D. Sealants:
1. Acrylic Sealant: FS TT-S-00230, Type II, Class B.
2. Butyl Tape Sealant: TT-C-1769A.
3. Polyurethane Sealant: FS TT-S00230C, Type II-nonsag, Class A.

2.3 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Fabricate cleats and starter strips of same material as sheet.

C. Form pieces in longest practical lengths.

D. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.

E. Form material with flat lock seam.

F. Fabricate corners from one piece with minimum 18 inch (450 mm long legs; seam for rigidity, seal with sealant.

G. Fabricate vertical faces with bottom edge formed outward 1/4 inch (6 mm) and hemmed to form drip.

PART 3 EXECUTION

3.1 INSPECTION

A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.

B. Verify membrane termination and base flashings are in place, sealed, and secure.

C. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

A. Field measure site conditions prior to fabricating work.

B. Install starter and edge strips, and cleats before starting installation.

C. Secure flashings in place using concealed fasteners.

D. Lock and seal all joints.

E. Apply plastic cement compound between metal flashings and felt flashings.

F. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 07 84 13
PENETRATION FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
   1. The work of this section shall include, but not be limited to, all clips and other restraining devices necessary for holding fire protection material in place and other items necessary for a complete and integral installation thru out the entire perimeter and other penetrations.

B. Related Sections include the following:
   1. Division 7 Section "Fire-Resistive Joint Systems."
   2. Division 15 Sections specifying duct and piping penetrations.
   3. Division 16 Sections specifying cable and conduit penetrations.

1.3 PERFORMANCE REQUIREMENTS

A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
   1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers, and smoke barriers.
   2. Fire-resistance-rated horizontal assemblies including floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.

B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per ASTM E 814 or UL 1479:
   1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
   2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
      a. Penetrations located outside wall cavities.

b. Penetrations located outside fire-resistance-rated shaft enclosures.

3. L-Rated Systems: Where through-penetration firestop systems are indicated in smoke barriers, provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 deg F.

C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by installing floor plates or by other means.
3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

1.4 SUBMITTALS

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

B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items. Retain subparagraph below only after verifying that authorities having jurisdiction will accept modifications handled by method in subparagraph.

C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
1. Types of penetrating items.
2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

D. Qualification Data: For Installer.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FMG according to FMG 4991, "Approval of Firestop Contractors."

B. Installation Responsibility: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single qualified installer.

C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
    a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
        1) UL in its "Fire Resistance Directory."

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration

firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated that are produced by one of the following manufacturers:
1. Grace, W. R. & Co. - Conn.
2. Hilti, Inc.
3. Nelson Firestop Products.
4. 3M; Fire Protection Products Division.
5. Tremco; Sealant/Weatherproofing Division.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:
    a. Slag-/rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. General: Provide through-penetration firestop systems containing the types of fill materials indicated. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.

B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

E. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

F. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.

G. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

H. 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, and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of work.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
   1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Through-penetration firestop system designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Through-penetration firestop system manufacturer's name.
   6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.

B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 07 90 00
JOINT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes sealants and joint backing, precompressed foam sealers, and accessories.

1.2 REFERENCES

A. ASTM International:
   1. ASTM C834 - Standard Specification for Latex Sealants.
   2. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
   3. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
   4. ASTM C1193 - Standard Guide for Use of Joint Sealants.
   5. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
   6. ASTM D1667 - Standard Specification for Flexible Cellular Materials-Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
   7. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

1.3 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures.

B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

C. Manufacturer's Installation Instructions: Submit special procedures, surface preparation, and perimeter conditions requiring special attention.

D. Warranty:
   1. Include coverage for installed sealants and accessories failing to achieve airtight seal and watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.
   2. Provide a 3-year written guarantee of the entire sealant installation against defects in materials and workmanship, together with a statement that the Contractor agrees to repair or replace, to the satisfaction of the Owner, at no additional cost to the Owner, any such defective areas which become evident within said 3-year guarantee period.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 01 60 00 – Product Requirements.

B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.6 COORDINATION

A. Section 01 31 00 – Project Management and Coordination.

B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.1 JOINT SEALERS

A. Manufacturers:
   1. Dow Corning Corp. Model.
   2. GE Silicones Model.
   3. Mameco International Inc. Model.
   4. Pecora Corp. Model.
   5. Sika Corp. Model
   6. Substitutions: Section 01 60 00 – Product Requirements.

B. Products Description:
   1. High Performance General Purpose Exterior (Nontraffic) Sealant: Polyurethane; ASTM C920, Grade NS, Class 25, Uses M, G, and A; single or multi- component.
      a. Type: Sikaflex-1a manufactured by Sika.
      b. Color: Standard colors matching finished surfaces.
      c. Applications: Use for:
         i. Control, expansion, and soft joints in masonry.
         ii. Joints between concrete and other materials.
         iii. Joints between metal frames and other materials.
         iv. Other exterior non-traffic joints for which no other sealant is indicated.
   2. General Purpose Traffic Bearing Sealant: Polyurethane; ASTM C920, Grade P, Class 25, Use T; single or multi- component.

a. Type: SikaFlex 1C-SL manufactured by Sika.
b. Color: Standard colors matching finished surfaces.
c. Applications: Use for exterior and interior pedestrian and vehicular traffic bearing joints.

3. Exterior Foam Expansion Joint Sealer: Precompressed foam sealer; Polyurethane with water-repellent; products recommended by manufacturer for traffic-bearing use.

a. Color: Black color.
b. Size: As required to provide weathertight seal when installed.
c. Applications: Use for exterior wall expansion joints.

4. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C834, single component, paintable.

a. Color: Standard colors matching finished surfaces.
b. Applications: Use for interior wall and ceiling control joints, joints between door and window frames and wall surfaces, and other interior joints for which no other type of sealant is indicated.:

5. Bathtub/Tile Sealant: White silicone; ASTM C920, Uses M and A; single component, mildew resistant.

a. Applications: Use for joints between plumbing fixtures and floor and wall surfaces, and joints between kitchen and bathroom toilet room counter tops and wall surfaces.

6. Sealant for Continuous Water Immersion: Polyurethane; NSF 61 Approved; ASTM C920, Grade NS, Class 25, Uses M and A; approved by manufacturer for continuous water immersion; single or multi- component.

a. Type: Sikaflex 1a manufactured by Sika.
b. Color: Standard colors matching finished surfaces.
c. Applications: Use for improved tank access.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056, sponge or expanded rubber; oversized 30 to 50 percent larger than joint width.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 31 00 – Project Management and Coordination.

B. Verify substrate surfaces and joint openings are ready to receive work.

C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

A. Remove loose materials and foreign matter impairing adhesion of sealant.

B. Clean and prime joints.

C. Perform preparation in accordance with ASTM C1193.

D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

A. Perform installation in accordance with ASTM C1193.

B. Perform acoustical sealant application work in accordance with ASTM C919.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

D. Install bond breaker where joint backing is not used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Tool joints concave.

H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.4 CLEANING

A. Section 01 77 00 – Closeout Procedures: Final cleaning.

B. Clean all adjoining surfaces of excess sealants and caulking, smears or markings due to application and leave joint with neat, uniformly-filled surface.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 77 00 – Closeout Procedures: Protecting installed construction.

B. Protect sealants until cured.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08 11 00
METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Steel doors.
2. Steel door frames.
3. Sidelight frames
4. Borrowed-light frames.

B. Related Sections include the following:
1. Division 4 Section "Unit Masonry Assemblies" for installing anchors and grouting frames in masonry construction.
2. Division 8 Section "Flush Wood Doors" for wood doors installed in steel frames.
3. Division 8 Section "Door Hardware" for door hardware and weather stripping.
4. Division 8 Section "Glazing" for glass in glazed openings.
5. Division 9 Section "Gypsum Board Assemblies" for spot-grouting frames installed in steel-framed gypsum board partitions.
6. Division 9 Section "Painting" for field painting factory-primed doors and frames.

1.3 DEFINITIONS

A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

1.4 SUBMITTALS

A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.

B. Shop Drawings: Show the following:
1. Elevations of each door design.
2. Details of doors including vertical and horizontal edge details.
3. Frame details for each frame type including dimensioned profiles.
4. Details and locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.

6. Details of anchorages, accessories, joints, and connections.
7. Coordination of glazing frames and stops with glass and glazing requirements.

C. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

D. Oversize Construction Certificates: For door assemblies required to be fire-protection rated and exceeding size limitations of labeled assemblies.

E. Metallic Construction Certificates: For door assemblies (doors and frames) required to be of metallic coated steel for compliance with this specification section.

1.5 QUALITY ASSURANCE

A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
1. Test Pressure: Test at atmospheric pressure.
2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4-inch-high wood blocking. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Steel Doors and Frames:

   a. Amweld Building Products, Inc.
   b. Ceco Door Products; a United Dominion Company.
   c. Curries Company.
   d. Kewanee Corporation (The).
   e. Pioneer Industries Inc.
   f. Republic Builders Products.
   g. Steelcraft; a division of Ingersoll-Rand.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 569/A 569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A 366/A 366M, Commercial Steel (CS), or ASTM A 620/A 620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Metallic-Coated Steel Sheets: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with an A40 zinc-iron-alloy (galvannealed) coating; stretcher-leveled standard of flatness.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized; suitable for unexposed applications; stretcher-leveled standard of flatness where used for face sheets.

2.3 DOORS

A. General: Provide doors of sizes, thicknesses, and designs indicated.

B. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 2 and Physical Performance Level A (Heavy Duty), Model 2 (Seamless) (18 gauge face).

C. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 4 and Physical Performance Level A (Maximum Duty), Model 2 (Seamless) (14 gauge face).

D. Vision Lite Systems: Manufacturer's standard kits consisting of glass lite moldings to accommodate glass thickness and size of vision lite indicated.

2.4 FRAMES

A. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.
1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
2. Frames for Level 4 Steel Doors: 0.067-inch- (1.7-mm-) (16 gauge) thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
2. Frames for Level 2 Steel Doors: 0.067-inch- (1.7-mm-) (16 gauge) thick steel sheet.
3. Frames for Wood Doors: 0.067-inch- (1.7-mm-) (16 gauge) thick steel sheet.
4. Frames for Borrowed Lights: 0.067-inch- (1.7-mm-) (16 gauge) thick steel sheet.

D. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.

E. Plaster Guards: Provide 0.016-inch-thick, steel sheet plaster guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.

F. Supports and Anchors: Fabricated from not less than 0.042-inch-thick, electrolytic zinc-coated or metallic-coated steel sheet.
1. Wall Anchors in Masonry Construction: 0.177-inch-diameter, steel wire complying with ASTM A 510 may be used in place of steel sheet.

G. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A 153/A 153M, Class C or D as applicable.

2.5 FABRICATION

A. General: Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that

cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.

B. Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053-inch- (1.3-mm-) thick, metallic-coated steel channels with channel webs placed even with top and bottom edges.

C. Interior Door and Panel Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from the following material:
   1. Cold-rolled steel sheet.
   2. Metallic-coated steel sheet at all wet areas.

D. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.

E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.

F. Clearances for Fire-Rated Doors: As required by NFPA 80.

G. Single-Acting, Door-Edge Profile: Beveled edge.

H. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

I. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

J. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

K. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.
   1. Unless otherwise indicated, provide thermal-rated assemblies with U-value of 0.37 Btu/sq. ft. x h x deg F or better.

L. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
   1. For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.

M. Frame Construction: Fabricate frames to shape shown.

1. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints.
2. For exterior applications, fabricate frames with mitered or coped and continuously welded corners and seamless face joints.
3. Provide welded frames with temporary spreader bars.
4. Provide terminated stops where indicated.
5. Provide metallic-coated steel sheet at all exterior locations and at all wet areas.

N. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
1. Provide auxiliary hinge reinforcement at all hinge locations on every frame.

O. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

P. Glazing Stops: Manufacturer's standard, formed from 0.032-inch-thick steel sheet.
1. Provide nonremovable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.

Q. Astragals: As required by NFPA 80 to provide fire ratings indicated.

2.6 FINISHES

A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

PART 3 EXECUTION

3.1 INSTALLATION

A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
1. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
2. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.

3. In existing concrete or masonry construction, provide at least three completed opening anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Set frames and secure to adjacent construction with bolts and masonry anchorage devices. Counter sink bolt head in door frame, cover with auto body Bondo sand smooth and paint.
4. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
5. Install fire-rated frames according to NFPA 80.
6. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.

C. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.
   1. Fire-Rated Doors: Install within clearances specified in NFPA 80.
   2. Smoke-Control Doors: Install to comply with NFPA 105.

3.2 ADJUSTING AND CLEANING

A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes hardware for wood, steel, aluminum doors.
   1. Provide door gaskets, including weather stripping and seals, and thresholds.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A156.1 - Butts and Hinges.
   2. ANSI A156.2 - Bored and Preassembled Locks and Latches.
   3. ANSI A156.3 - Exit Devices.
   4. ANSI A156.4 - Door Controls - Closures.
   5. ANSI A156.5 - Auxiliary Locks and Associated Products.
   6. ANSI A156.6 - Architectural Door Trim.
   7. ANSI A156.7 - Template Hinge Dimensions.
   8. ANSI A156.8 - Door Controls - Overhead Holders.
   9. ANSI A156.12 - Interconnected Locks and Latches.
   10. ANSI A156.13 - Mortise Locks and Latches.
   11. ANSI A156.14 - Sliding and Folding Door Hardware.
   12. ANSI A156.15 - Closer Holder Release Devices.
   13. ANSI A156.16 - Auxiliary Hardware.
   14. ANSI A156.18 - Materials and Finishes
   15. ANSI A156.19 - Power Assist and Low Energy Power Operated Doors.
   16. ANSI A156.23 - Electromagnetic Locks.
   17. ANSI A156.24 - Delayed Egress Locks.
   18. ANSI A156 - Complete Set of 24 BHMA Standards (A156 Series) with Binder.

B. Builders Hardware Manufacturers Association:
   1. BHMA Directory of Certified Products.

C. National Fire Protection Association:
   1. NFPA 80 - Standard for Fire Doors, Fire Windows.
   2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

D. Underwriters Laboratories Inc.:
   1. UL 10B - Fire Tests of Door Assemblies.
   2. UL 305 - Panic Hardware.
   3. UL - Building Materials Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Fire Rated Openings: Provide door hardware listed by UL or Intertek Testing Services (Warnock Hersey Listed), or other testing laboratory approved by applicable authorities.
   1. Hardware: Tested in accordance with NFPA 252.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings:
   1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements.
   2. Submit manufacturer's parts lists, and templates. Coordinate with security gate manufacturer for installation and proper fit.

C. Manufacturer's Installation Instructions: Submit special procedures, and perimeter conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of installed cylinders and their master key code.

C. Operation and Maintenance Data: Submit data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

D. Keys: Deliver with identifying tags to Owner by security shipment direct from hardware supplier.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the following requirements:
   1. ANSI A156 series.
   2. NFPA 80.
   3. UL 305.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Hardware Supplier: Company specializing in supplying commercial door hardware with minimum three years documented experience.

C. Products Requiring Electrical Connection: Listed and classified by [Underwriters' Laboratories, Inc., as suitable for purpose specified and indicated.

1.8 PRE-INSTALLATION MEETINGS

A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

C. Include persons involved with installation of doors, frames, and hardware.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Package hardware items individually with necessary fasteners, instructions, and installation templates, when necessary; label and identify each package with door opening code to match hardware schedule.

1.10 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
   1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.

C. Sequence installation to accommodate required utility connections.

D. Coordinate Owner's keying requirements during course of Work.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

B. Furnish five-year manufacturer warranty for locksets and door closers.

1.12 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance materials.

B. Furnish maintenance tools and accessories supplied by hardware component manufacturer.

C. Furnish special wrenches and tools applicable for each different and for each special hardware component.

1.13 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish ten extra keys for each master keyed group.

PART 2 PRODUCTS

2.1 DOOR HARDWARE

A. Manufacturers:
1. Accurate Metal Weather Strip Co. Inc.
2. American Device Manufacturing Co.
3. Arrow Architectural Hardware
4. Bommer Industries, Inc.
5. Clipenglyde, Inc.
6. Dorma Door Controls, Inc.
7. NT Falcon Lock
8. Glynn-Johnson
9. Hager Companies
10. Holmes-Hally Industries, Inc.
11. LCN Closers
12. Markar Products, Inc.
13. NT Monarch Hardware
14. Precision Hardware Mfg Co Inc.
15. Reese Industries
16. Sash Controls Inc.
17. Schlage Lock Co.
18. Stanley Hardware
19. Von Duprin, Inc.

B. Hinge Manufacturers:
1. Bommer Industries, Inc.
2. Hager Companies
3. Stanley Hardware

C. Lockset, Latch Set, and Cylinder Manufacturers:
1. Schlage Lock Co.
2. Yale
3. Wieser

D. Closers Manufacturers:
1. Arrow Architectural Hardware
2. Dorma Door Controls, Inc
3. LCN Closers

4. Yale

E. Push/Pulls Manual Bolts, Thresholds, and Trim Manufacturers:
   1. Schlage Lock Co
   2. Reese Industries
   3. Pemko

F. Substitutions: Section 01 60 00 – Product Requirements.

2.2 COMPONENTS

A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.
   1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
   2. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
   3. Fasteners: Furnish as recommended by hardware manufacturer and as required to secure hardware.
      a. Finish: Match hardware item being fastened.
   4. Fire Ratings: Provide hardware with UL or Intertek Testing Services (Warnock Hersey Listed) listings for type of application involved.
   5. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

B. Hinges: ANSI A156.1, full mortise type complying with following general requirements unless otherwise noted on drawings.
   1. Widths: Sufficient to clear trim projection when door swings 180 degrees.
   2. Number: Furnish minimum three hinges to 90 inches high, four hinges to 120 inches high for each door leaf.
      a. Fire Rated Doors To 86 inches High: Minimum three hinges.
      b. Residential Wood Doors: Furnish minimum three hinges.
   3. Size and Weight: 4-1/2 inch heavy weight typical for 1-3/4 inch doors.
      a. Doors Over 40 inches Wide: Extra heavy weight ball or oilite bearing hinges.
      b. Doors 1-3/8 inch Thick: 3-1/2 inch size.
      c. Doors 2 inch Thick: 5 inch extra heavy weight ball or oilite bearing.
      d. Doors Over 48 inches Wide: 5 inch extra heavy weight ball or oilite bearing.
   4. Pins: Furnish nonferrous hinges with non-removable pins (NRP) at exterior and locked outswinging doors, non-rising pins at interior doors.
   5. Tips: Flush tips

C. Pivots: ANSI A156.1 and A156.4, center ~~[offset full mortise]~~ pivots.
   1. Size: As recommended by pivot manufacturer for size and weight of door.

D. Locksets: Furnish locksets compatible with specified cylinders. Typical 2-3/4 inch (70 mm) backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt [verify type of cutouts provided in metal frames].
   ~~1. Mortise Locksets: ANSI A156.13, Series 1000, Grade 1 unless otherwise indicated.~~
   2. Bored (Cylindrical) Locksets: ANSI A156.2, Series 4000, Grade 1 unless otherwise indicated. SFCI 7 pin.
   3. Preassembled (Unit) Locksets: ANSI A156.12, Series 2000, Grade 1 unless otherwise indicated.
   4. Interconnected Locksets: ANSI A156.12, Series 5000, Grade 1 unless otherwise indicated.
   5. Auxiliary Locksets: ANSI A156.5, Grade 1, bored dead locks unless otherwise indicated.

E. Latch Sets: Match locksets. Typical 2-3/4 inch backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt verify type of cutouts provided in metal frames.
   ~~1. Mortise Latch Sets: ANSI A156.13, Series 1000, Grade 3 unless otherwise indicated.~~
   2. Bored (Cylindrical) Latch Sets: ANSI A156.2, Series 4000, Grade 3 unless otherwise indicated. SFCI 7 pin.

F. Cylinders: ANSI A156.5, Grade 1, SFCI 7 pin.
   1. Keying: Keyed as directed by Owner. Keyed in like-groups. Master keyed.
   2. Include construction keying.
   3. Keys: Nickel silver. Stamp keys with “DO NOT DUPLICATE”.
   4. Supply keys in the following minimum quantities:
      a. 10 master keys.

G. Closers: ANSI A156.4 closers; full rack and pinion type with steel spring and non-freezing hydraulic fluid; closers required for fire rated doors unless otherwise indicated.
   1. Adjustability: Furnish controls for regulating closing, latching, speeds, and back checking.
   2. Arms: Type to suit individual condition; parallel-arm closers at reverse bevel doors and where doors swing full 180 degrees.
   3. Location: Mount closers on inside of exterior doors, room side of interior doors typical; mount on pull side of other doors.
   4. Operating Pressure: Maximum operating pressure as follows.
      a. Interior Doors: Maximum 5 pounds.
      b. Exterior Doors: Maximum 8.5 pound.
      c. Fire Rated Doors: As required for fire rating, maximum 15 pounds.

H. Door Controls and Overhead Holders: Furnish with accessories as required for complete operational installation.
   1. Manual Door Holders and Overhead Stops: ANSI A156.8, Grade 1 types as specified
   2. Closer Holder Release Devices: ANSI A156.15 closers.
   3. Electro-Magnetic Door Holder: ANSI A156.15.
   4. Power Assist Door Operators: ANSI A156.19 power mechanism which reduces opening resistance of self-closing door.
   5. Low Energy Power Door Operators: ANSI A156.19 power mechanism which opens and closes door upon receipt of signal.
   6. Low Energy Power Open Door Operators: ANSI A156.19 power mechanism which opens self-closing door; closing of door independent of power operator.
   7. Key pad entry system: AlarmLock DL2800 or approved equal.

I. Push/Pulls, Manual Bolts, Thresholds, and Trim: Furnish as indicated in Schedule, with accessories as required for complete operational door installations.
   1. Push/Pulls: ANSI A156.6; push plates minimum 0.050 inch thick. Furnish [push-pull plate] type pulls with bolts to secure from opposite door face; furnish with minimum 0.050 inch pull plates unless otherwise indicated.
   2. Manual Bolts: ANSI A156.16 Grade 1 top and bottom flush bolts, with dust-proof floor strike, unless otherwise indicated. For doors taller than 7 feet, an extension will need to be provided for the top flush bolt.
   3. Kickplates: ANSI A156.6, metal; height indicated in Schedule by 1 inch less than door width; minimum 0.050 inch thick stainless steel.
   4. Weatherstripping: Furnish continuous weatherstripping at top and sides of exterior doors.
   5. Thresholds: Maximum 1/2 inch height.
   6. Floor Stops: With door holder.
   7. Wall Stops: ANSI A156.1, Grade 1, 2-1/2 inch wall stop concave pad wall stop with visible screws.

2.3 ACCESSORIES

A. Lock Trim: Furnish levers with escutcheon plate as selected from manufacturer's full range of levers.
   1. Do not permit through bolts on solid wood core doors.

B. Through Bolts: Do not permit through bolts and grommet nuts on door faces in occupied areas unless no alternative is possible.
   1. Do not use through bolts on solid wood core doors.

2.4 FINISHING

A. Finishes: ANSI A156.18; furnish following finishes except where otherwise indicated in Schedule at end of section.
   1. Hinges:

a. BHMA 630 and 626, satin finish.

2. Typical Exterior Exposed and High Use Interior Door Hardware:
   a. BHMA 630, satin finished stainless steel.
3. Typical Interior Door Hardware:
   a. BHMA 630, satin finished stainless steel.
4. Closers: Finish appearance to match door hardware on same face of door.
   a. BHMA 628, satin aluminum, clear anodized.
5. Thresholds: Finish appearance to match door hardware on exterior face of door.
   a. BHMA 628, satin aluminum, clear anodized.
6. Other Items: Furnish manufacturer's standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify doors and frames are ready to receive door hardware and dimensions are as indicated on shop drawings and/or as instructed by manufacturer.

C. Verify electric power is available to power operated devices and is of correct characteristics.

3.2 INSTALLATION

A. Coordinate mounting heights with door and frame manufacturers. Use templates provided by hardware item manufacturer.

B. Mounting Heights from Finished Floor to Center Line of Hardware Item: Comply with manufacturer recommendations and applicable codes where not otherwise indicated.
   1. Locksets: 38 inch
   2. Push/Pulls: 42 inch
   3. Dead Locks: 48 inch
   4. Push Pad Type Exit Devices: 42 inch
   5. Cross Bar Type Exit Devices: 38 inch
   6. Top Hinge: Jamb manufacturer's standard, but not greater than 10 inches from head of frame to center line of hinge.
   7. Bottom Hinge: Jamb manufacturer's standard, but not greater than 12-1/2 inches from floor to center line of hinge.
   8. Intermediate Hinges: Equally spaced between top and bottom hinges and from each other.

9. Hinge Mortise on Door Leaf: 1/4 inch. to 5/16 inch from stop side of door.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

3.4 ADJUSTING

A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust hardware for smooth operation.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.

B. Do not permit adjacent work to damage hardware or hardware finish.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Windows.
   2. Doors.
   3. Glazed entrances.
   4. Interior borrowed lites.
   5. Storefront framing.

1.3 DEFINITIONS

A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.

D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.

E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions.

Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:

   a. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings. Design wind load shall be minimum 50 mph.

   b. Specified Design Snow Loads: As indicated, but not less than snow loads applicable to Project as required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7.0, "Snow Loads."

   c. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.

      Load Duration: 60 seconds or less.

   d. Probability of Breakage for Sloped Glazing: 1 lite per 1000 for lites set more than 15 degrees off vertical and under wind and snow action.

      1) Load Duration: 30 days.

   e. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less.

      1) For monolithic-glass lites heat treated to resist wind loads.
      2) For insulating glass.
      3) For laminated-glass lites.

   f. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

   g. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.

C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
   2. For laminated-glass lites, properties are based on products of construction indicated.
   3. For insulating-glass units, properties are based on units with lites 6.0 mm thick and a nominal 1/2-inch- (12.7-mm-) wide interspace.
   4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
      a. U-Factors: NFRC 100 expressed as Btu/ sq. ft. x h x deg F (W/sq. m x K).
      b. Solar Heat Gain Coefficient: NFRC 200.
      c. Solar Optical Properties: NFRC 300.

1.5 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass.
   1. Each color of tinted float glass.
   2. Each type of patterned glass.
   3. Coated vision glass.
   4. Ceramic-coated spandrel glass.
   5. Each pattern and color of ceramic-coated vision glass.
   6. Fire-resistive glazing products.
   7. Each type of laminated glass with colored interlayer.
   8. Insulating glass for each designation indicated.
   9. For each color (except black) of exposed glazing sealant indicated.

C. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.

D. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
   1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

E. Qualification Data: For installers.

F. Preconstruction Adhesion and Compatibility Test Report: From glazing sealant manufacturer indicating glazing sealants were tested for adhesion to glass and glazing channel substrates and for compatibility with glass and other glazing materials.

G. Product Test Reports: For each of the following types of glazing products:
1. Tinted float glass.
2. Coated float glass.
3. Insulating glass.
4. Glazing sealants.
5. Glazing gaskets.

H. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, coated float glass, laminated glass, and insulating glass.

C. Source Limitations for Glass Sputter-Coated with Solar-Control Low-E Coatings: Where solar-control low-e coatings of a primary glass manufacturer that has established a certified fabricator program is specified, obtain sputter-coated solar-control low-e-coated glass in fabricated units from a manufacturer that is certified by coated-glass manufacturer.

D. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

E. Glass Product Testing: Obtain glass test results for product test reports in "Submittals" Article from a qualified testing agency based on testing glass products.
1. Glass Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

F. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.

2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

G. Preconstruction Adhesion and Compatibility Testing: Submit to elastomeric glazing sealant manufacturers, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that will contact or affect elastomeric glazing sealants:
1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
5. Testing will not be required if elastomeric glazing sealant manufacturers submit data based on previous testing of current sealant products for adhesion to, and compatibility with, glazing materials matching those submitted.

H. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

I. Glazing for Fire-Rated Window Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

J. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201.
1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 sq. ft. (0.84 sq. m) in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 sq. ft. (0.84 sq. m) or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

K. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are

indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Sloped Glazing Guidelines."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units."

L. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following testing and inspecting agency:

1. Insulating Glass Certification Council.

M. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Build glass mockups by installing the following kinds of glass in mockups specified in Division 8 Section "Aluminum-Framed Entrances and Storefronts@ and AGlazed Aluminum Curtain Walls" to match glazing systems required for Project, including glazing methods:
    a. Heat-strengthened coated glass.
    b. Fully tempered glass.
    c. Spandrel glass.
    d. Laminated glass.
    e. Coated insulating glass.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

N. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.9 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: Five years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
   2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass), Quality-Q3; of class indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
   2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
   3. For uncoated glass, comply with requirements for Condition A.
   4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
   5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

C. Ceramic-Coated Vision Glass: Float glass with ceramic enamel applied by silk-screened process and complying with ASTM C 1048, Condition C (other coated glass), Type I (transparent flat glass), Quality-Q3, Specification No. 95-1-31 in GANA Tempering Division's "Engineering Standards Manual," and other requirements specified.

D. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.

E. Coated Spandrel Float Glass: Float glass complying with other requirements specified and with the following:
   1. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.
   2. Factory apply manufacturer's standard opacifier of the following material to coated second surface of lites, with resulting products complying with Specification No. 89-1-6 in GANA Tempering Division's "Engineering Standards Manual."
      a. Manufacturer's standard opacifier material.

F. Laminated Glass: ASTM C 1172, and complying with other requirements specified and with the following:
   1. Interlayer: Polyvinyl butyral of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
      a. For polyvinyl butyral interlayers, laminate lites in autoclave with heat plus pressure.

2. Laminating Process: Fabricate laminated glass to produce glass free of foreign substances and air or glass pockets.

G. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.
1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
2. Provide Kind FT (fully tempered) glass lites where safety glass is indicated.
3. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
4. Sealing System: Dual seal, with primary and secondary sealants as follows:
    a. Polyisobutylene and hot-melt butyl.
5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
    a. Spacer Material: Aluminum with mill or clear anodic finish.
    b. Desiccant: Molecular sieve or silica gel, or blend of both.
    c. Corner Construction: Manufacturer's standard corner construction.

2.3 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
1. EPDM, ASTM C 864.
2. Silicone, ASTM C 1115.
3. Thermoplastic polyolefin rubber, ASTM C 1115.
4. Any material indicated above.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
1. EPDM.
2. Silicone.
3. Thermoplastic polyolefin rubber.
4. Any material indicated above.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.4 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:
   1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
   1. Single-Component Neutral- and Basic-Curing Silicone Glazing Sealants:
      a. Available Products:
         1) Dow Corning Corporation; 790.
         2) GE Silicones; SilPruf LM SCS2700.
         3) Tremco; Spectrem 1 (Basic).
      b. Type and Grade: S (single component) and NS (nonsag).
      c. Class: 100/50.
      d. Use Related to Exposure: NT (nontraffic).
      e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
         1) Use O Glazing Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and wood.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
   1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
   1. Type 1, for glazing applications in which tape acts as the primary sealant.
   2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.7 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.

C. Grind smooth and polish exposed glass edges and corners.

2.8 MONOLITHIC FLOAT-GLASS UNITS

A. Uncoated Clear Float-Glass Units: Class 1 (clear) annealed or Kind HS (heat-strengthened) float glass where heat strengthening is required to resist thermal stresses induced by differential shading of individual glass lites and to comply with system performance requirements and Kind FT (fully tempered) float glass.
   1. Thickness: Not less than 6.0 mm.
   2. Uncoated Clear Fully Tempered Float Glass: Kind FT (fully tempered).

2.9 LAMINATED-GLASS UNITS

A. Heat-Treated Laminated-Glass Units:
   1. Kind LHS, consisting of two lites of heat-strengthened float glass.
   2. Outer Lite: Class 1 clear float glass.
      a. Kind HS (heat strengthened).
      b. Thickness: 3.0 mm.
   3. Inner Lite: Class 1 (clear) float glass.
      a. Kind HS (heat strengthened).
      b. Thickness: 3.0 mm.
   4. Plastic Interlayer:
      a. Thickness: 0.060 inch (1.52 mm), but not less than that required to comply as a Type II safety glass material.
      b. Interlayer Color: Clear.

2.10 INSULATING-GLASS UNITS

A. Solar Control Low-E Insulating Glass: Where glass of this designation is indicated, provide low-emissivity insulating-glass units complying with the following:
   1. Products: Available products include the following:
      a. PPG SOLARBAN 60 (2) SOLARGRAY.
   2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm.
   3. Interspace Content: Air.
   4. Indoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.
      a. Kind HS (heat strengthened), Condition C (other coated glass).
   5. Outdoor Lite: Type I (transparent glass, flat) float glass.
      a. Class 2 (tinted) float glass.
         1) Tint Color: SOLARGRAY
      b. Kind HS (heat strengthened), Condition A (uncoated surfaces) or Kind FT (fully tempered), Condition A (uncoated surfaces).
   6. Low-Emissivity Coating: Sputter on third surface.
   7. Visible Light Transmittance: 60%
   8. Winter Nighttime U-Value: 0.29
   9. Summer Daytime U-Value: 0.30
   10. Solar Heat Gain Coefficient: 0.36
   11. Outdoor Visible Reflectance: 11%
   12. Shading Coefficient: 0.41.

B. Ceramic-Coated Spandrel Insulating Glass: Where glass of this designation is indicated, provide insulating-glass units complying with the following:
   1. Products: Available products include the following:

a. Match adjacent glazing panels.

2. Construction: Provide units that comply with requirements specified for insulating-glass units except for indoor lite.
3. Indoor Lite: Ceramic-coated spandrel glass.
   a. Kind HS (heat strengthened) or Kind FT (fully tempered).
   b. Ceramic Coating Location: Fourth surface.
   c. Color: As selected by Architect from manufacturer's full range.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine framing glazing, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep system.
   3. Minimum required face or edge clearances.
   4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) as follows:
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant where indicated.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances

do come into contact with glass, remove substances immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Surface preparation and field application of paints and coatings.

1.2 REFERENCES

A. ASTM D16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.

B. NACE (National Association of Corrosion Engineers) - Industrial Maintenance Painting.

C. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.

D. NPCA (National Paint and Coatings Association) – Guide to U.S. Government Paint Specifications.

E. PDCA (Painting and Decorating Contractors of America) Painting - Architectural Specifications Manual.

1.3 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. The Contractor shall submit a written copy of the coating manufacturer's recommendations for the shipping, handling, storage, application, curing, recoating and disposal of all products used for this project.

C. Manufacturer's Instructions: Indicate special surface preparation procedures and substrate conditions requiring special attention.

D. The Contractor shall supply color chips for available colors. Owner will make color selection.

1.5 CLOSEOUT SUBMITTALS

A. Section 01 77 00 – Closeout Procedures.

B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years experience.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable code for flame and smoke rating requirements for finishes.

B. All pertinent safety regulations shall be adhered to strictly. All OSHA, federal, state regulations will be observed and conformed to. Material safety data sheets shall be submitted by the product manufacturer and such precautions enforced.

C. Contractor shall be fully responsible for the generation, management, and disposal of hazardous waste materials which are generated by the Work. Contractor shall comply with all local, state, and federal regulations regarding removal, containment, and disposal of the cleaning and painting debris.

1.8 FIELD SAMPLES

A. Provide field sample of paint under provisions of Section 01 45 00 – Quality Control.

B. Provide field sample panel, 2 feet long by 1 foot wide, illustrating special coating color, texture, and finish.

C. Locate where directed.

D. Accepted sample may remain as part of the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 – Product Requirements.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Store paint materials at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

E. Take all necessary precautionary measures to prevent fire hazards and spontaneous combustion. Open containers of materials only as needed for use; keep closed when not in use. Keep oily/finish material and soaked rags in tightly closed containers. Dispose of used rags off the site daily; remove empty containers from the site daily.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.

C. Minimum Application Temperatures for Latex Paints: 45 degrees F (7 degrees C) for interiors; 50 degrees F (10 degrees C) for exterior; unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperature for Alkyd Finishes: 65 degrees F (18 degrees C) for interior exterior, unless required otherwise my manufacturer's instructions.

E. Provide lighting level of 80 ft. candles measured mid-height at substrate surface.

F. Dispose of all sand blasting and cleaning materials off-site, and in conformance with applicable local, state, and federal regulations.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Section 01 77 00 – Closeout Procedures.

B. Provide 1 gallon of each color, type, and surface texture to Owner.

C. Label each container with color, type, texture, and locations, in addition to the manufacturers' label.

D. Supply the Owner with one copy of the color schedule.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers - Paint
   1. Benjamin Moore.
   2. Sherwin Williams.
   3. Tnemec Company
   4. Pittsburg Paint.
   5. Mobile Chemical Company.
   6. Ponderosa Paint.
   7. Ameron International.

B. Paint and coating materials shall be highest quality material. Trade names used herein refer to materials manufactured and are used to establish a basis of quality for bidding. The Engineer or Architect is not bound to approve all types of paint from any one manufacturer. Material for each general purpose shall be of the same manufacturer

and materials of different manufacturer shall not be used over one another, except for shop prime coats applied under Sections of the Project Manual.

C. Special systems as specified for surface conditions by the manufacturer specified; substitution only upon affidavit of alternate manufacturer that product will meet conditions and label for surface use.

2.2 MATERIALS

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, and of commercial quality.

C. Patching Materials: Latex filler.

D. Fastener Head Cover Materials: Latex filler.

2.3 FINISHES

A. Refer to schedule at end of section for surface finish schedule.

2.4 COLORS

A. Paint colors shall be approved by the Owner submit color patches.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Section 01 31 00 – Project Management and Coordination.

B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application. The Painting Contractor shall be responsible for examination and acceptance of all surfaces and conditions affecting proper application of the materials, and shall not proceed until unsatisfactory conditions have been corrected; the application of the first coat of a finish system to any surface shall constitute acceptance of that surface.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
   3. Interior Wood: 15 percent, measured in accordance with ASTM D-2016.
   4. Exterior Wood: 15 percent, measured in accordance with ASTM D-2016.

3.2 PREPARATION

A. Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Correct defects and clean surfaces which affect work of this section. Remove existing coatings that exhibit loose surface defects.

C. Seal with shellac and seal marks which may bleed through surface finishes.

D. Gypsum Board Surfaces: Fill minor defects with filler compound. Remove spackle drops, mortar, dust, and dirt. Spot prime defects after repair. Surface to be crack fee, properly finished and clean.

E. Concrete and Unit Masonry Surfaces Scheduled to Receive Stain or Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry. Repair surfaces in concrete and masonry in accordance with Section 03 30 00 – Cast-In-Place Concrete and 04 22 00 – Concrete Unit Masonry, respectively.

F. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

G. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

H. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

I. Hot Dip Galvanized Surfaces Touch Up: Sand and scrape to remove loose surface.

J. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.

K. Metal Doors and Frames Scheduled for Painting: Seal top and bottom edges with primer.

L. Wood: Remove grade marks; seal knots with suitable sealer. Hand sand woodwork and trim; dust clean. All nail holes to be filled with suitable interior or exterior grade filler compound.

3.3 APPLICATION

A. Apply products in accordance with manufacturer's instructions.

B. Do not apply finishes to surfaces that are not dry.

C. Apply each coat to uniform finish. Each coat of paint or finish shall be applied at proper consistency according to the manufacturer's directions; brushed evenly, and free of brush marks, sags, and runs, with no evidence of poor workmanship. Care shall be exercised to avoid lapping; paint to be sharply cut to lines. Finished surfaces shall be free from defects or blemishes. Pores of CMU block shall be filled with no air pockets.

D. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.

E. Sand metal lightly between coats to achieve required finish.

F. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

G. Allow applied coat to dry before next coat is applied.

3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Paint shop primed equipment.

B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

C. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, and equipment except where items are prefinished.

D. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.5 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 45 00 – Quality Control.

B. Test questionable coated areas in accordance with Engineers Instructions.

3.6 CLEANING

A. Clean work under provisions of Section 01 77 00 – Closeout Procedures.

B. Collect waste material, which may constitute a fire hazard, place in closed metal containers and remove daily from site.

3.7 SCHEDULE - EXTERIOR SURFACES

A. Wood Trim:
   1. One coat wood primer. No. 03-721PP
   2. Two coats alkyd semi-gloss enamel. No. 03-241WB

B. Steel/Miscellaneous Metals - Shop Primed:
   1. Touch-up with compatible primer. No. 04-022PP
   2. Two coats of polyurethane enamel, gloss. No. 04-400WB

C. Steel/Miscellaneous Metals – Unprimed:
   1. One coat of primer/neutralizer. No. 04-022PP
   2. Two coats of alkyd gloss enamel. No. 03-241WB

D. Steel - Galvanized:
   1. One coat galvanize primer.
   2. Two coats of alkyd gloss enamel. No. 03-241WB

E. Roof and Ground Mounted Electrical/Mechanical Equipment, Duct Work, and Piping:
   1. Factory primed or painted - two coats alkyd low gloss enamel, No. 03-241WB (including electrical transformers and gas meters).

F. Concrete Masonry Units (Clear, No Color):
   1. PROSOCO Blok-Guard & Graffiti Control II. Anti-Graffiti coverage per manufacturer's recommendations.

3.8 SCHEDULE - INTERIOR SURFACES

A. For water containment structures, all interior paints and coatings shall be NSF 61 approved.

B. Steel/Miscellaneous Metals – Unprimed:
   1. One coat of alkyd primer. No. 04-022PP
   2. Two coats of polyurethane enamel, gloss. No. 04-400WB

C. Steel/Miscellaneous Metals – Primed:
   1. Touch-up with alkyd primer. No. 04-022PP
   2. Two coats of polyurethane enamel, gloss. No. 04-400WB

D. Steel - Galvanized:
   1. One coat galvanize primer.
   2. Two coats of alkyd enamel, gloss. No. 03-241WB

E. Ducts and Uncovered Piping of Heating System in Finished Spaces
   1. Prime. Two coats alkyd satin industrial enamel, first coat thinned 8/1 with mineral spirits.

F. Wood Trim – Painted:
   1. One coat primer. No. 05-200PP
   2. One coat semi-gloss latex. No. 03-241WB

G. Metal Doors and Frames:
   1. Touch up abraded prime coat. No. 04-022PP
   2. Two coats of alkyd semi-gloss enamel. No. 03-241WB

H. Concrete Masonry Units
   1. One coat 100% Acrylic Laytex Block Filler. No. 05-055PP.
   2. Two coats Acry-Plus semi-gloss. No. 02-252WB

I. Gypsum Board
   1. One coat latex vapor shield wall primer. No. 02-725PP
   2. Two coats semi-gloss latex enamel. No. 02-252WB

3.9 SCHEDULE - COLORS

A. As approved by Owner, and accepted by Engineer. Submit color patches as required in Section 01 33 00 – Submittal Procedures.

3.10 CLEANING AND REPAIRING

A. Painter responsible for all defective work no matter what the cause, including unsuitable and improperly prepared surfaces; refinish at Painter's expense. Painted surfaces shall be free from defects in workmanship or materials. Repair work damaged during construction before time of final project acceptance; touch-up or refinish as necessary abraded, stained or otherwise disfigured surfaces.

3.11 CLEAN UP

A. During painting, clean up, remove from project, containers and cartons, rubbish, and rags resulting from work of this section. Maintain premises in clean, orderly condition at all times. Upon completion remove rubbish, tools, equipment, unused products from project.

3.12 LABELS

A. All exposed piping shall be labeled with permanent contrasting color and flow direction arrows spaced no more than 25 feet on center and at every wall, floor or ceiling penetration.

B. Labeling shall be pre-printed by W.H. Brady Co., Seton Name Plate Corp. or approved equivalent, mechanically attached at both ends. Letters shall be a minimum of 2" in height.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 23 05 00
GENERAL HVAC REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

Sections of other Divisions which relate to HVAC work apply to the work of this section. See various Sections on sitework, underfloor work, structural work, finish materials, etc.

Related Sections: Refer to Section 23 06 07 "Motors, Drives & Electrical Requirements' for basic electrical requirements for all HVAC equipment. Special and specific electrical requirements are specified within each respective equipment specification section.

Section 26 05 00 – "Electrical General Requirements" applies to the HVAC work.

1.2 SUMMARY: This Section specifies the basic requirements for HVAC installations and includes requirements common to more than one of the Division 23 HVAC sections. It expands and supplements the requirements of Division 1 and the Mechanical Sections 21, 22 and 33.

This Division does not define, nor is it limited by, trade jurisdictions. All work described herein is a part of the General Contract and is required of the Contractor regardless.

1.3 DESCRIPTION OF PROJECT: The HVAC work described in these Division 23 specifications is for Harper Ward Well House project located in Box Elder County, Utah. Design weather conditions are: 95°F db, 63°F wb and winter 0°F. Altitude readings, unless otherwise noted, are for an elevation of approximately 4,500 feet above sea level. Make adjustment to manufacturer's performance data as needed.

Work includes:

A. HVAC systems for the New Well House and related facilities.

1.4 CODES AND PERMITS, AUTHORITIES HAVING JURISDICTION:

A. Perform the HVAC work in strict accordance with the applicable provisions of the various codes. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications govern.

B. Hold and save the Owner and Engineer free and harmless from liability of any nature or kind arising from Contractor failure to comply with codes and ordinances.

C. Secure permits necessary for the prosecution of the work under this contract. Contractor to pay all fees.

D. Referenced Standards:

American Welding Society
International Mechanical Code/State Code
International Building Code/State Code
International Plumbing Code with amendments
International Fuel Gas Code 2006
SMACNA Duct Design Standards
Locally enforced NFPA Codes
NFPA 90A related to general Heating and Ventilation
NFPA 820 related to Ventilation of Water Treatment Plants
Local Fuel Utility Regulations
Local Power Utility Regulations
American Gas Association Standards
ASME Codes for Pressure Vessels and Piping
ANSI B31.1 Piping

E. Review of work in progress will be made throughout the course of the work. Final review by the Engineer will not be made nor Certificate of Substantial Completion issued until certificates of acceptability from the Authorities having jurisdiction are delivered.

1.5 DEFINITION OF PLANS AND SPECIFICATIONS: The HVAC drawings at reduced scale show the general arrangement of piping, ductwork, equipment, etc., and, after prior coordination, are to be followed as closely as the actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as part of the work insofar as these drawings furnish the Contractor with information relating to design and construction of the building. Structural, Architectural, Mechanical and Electrical drawings take precedence over HVAC drawings. Request clarification and participate in resolution in the event of conflict.

Because of the small scale of the HVAC drawings, it is neither possible nor intended to indicate all offsets, fittings and accessories which may be required. Investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing such extensions, offsets, adaptations, fittings, valves and accessories to meet the conditions as may be required. Some small scale work is not shown such as control conduit and piping, incidental piping, and specialties. Only those who are experienced in this type of construction are invited to the work. Provide in complete detail as directed by note, specification, and common “good practice or standard.”

Examine the actual construction site prior to bidding and obtain an understanding of the existing conditions under which the work will be performed. No allowances will be made for failure to make such examination.

During construction, set up the rough work, and verify the evolving dimensions governing the HVAC work at the building. Do not claim or expect extra compensation because of differences between actual dimensions and those indicated on the drawings. Examine adjoining work on which HVAC work is dependent for perfect efficiency, and report any work of other trades which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to unfavorable construction consequent conditions affecting the HVAC work.

1.6 ROUGH-IN:

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 3 through 44 for rough-in requirements.

1.7 HVAC INSTALLATIONS:

A. Equipment Arrangement: Unless specifically indicated otherwise, the arrangement of equipment indicated is based upon information available at the time of design and is not intended to show exact dimensions particular to a specific manufacturer. Some aspects of the drawings are diagrammatic and some features of the illustrated equipment arrangement may require revision to meet the actual equipment requirements. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the installation of equipment.

B. Coordinate HVAC equipment and materials installation with other building components.

C. Verify all dimensions by field measurements.

D. Arrange for chases, slots, and openings in other building components to allow for HVAC installations.

E. 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.

F. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

G. Coordinate the cutting and patching of building components to accommodate installation of HVAC equipment and materials.

H. Where mounting heights are not detailed or dimensioned, install HVAC services and overhead equipment to provide the maximum headroom possible.

I. Install HVAC equipment to facilitate 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.

J. Coordinate the installation of HVAC materials and equipment above ceilings with suspension system, light fixtures, and other installations.

K. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

L. Where HVAC work penetrates other trade work such as poured in place concrete, gypsum board or masonry walls, etc., penetration shall be neatly cut and sleeved, and the rough wall opening shall be filled and patched.

1.8 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Equipment Supports: Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads as stated in the 2015 (or latest edition) International Building Code (IBC), Chapter 16 and ASCE 7-05. Submitted design calculations for equipment supports and anchorage shall bear the signature and seal of a Registered Professional Engineer licensed in the State of Utah, unless otherwise indicated. Calculations shall account for forces and distribution of forces on supporting structures resulting from normal operation, normal operation plus seismic loadings, normal operation plus wind loadings, as well as the other load combinations stated the 2006 IBC.

B. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches above the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.

C. Wind Load: The wind load shall be calculated in accordance with ASCE 7-05, Chapter 6, using the following design parameters:

1. Wind Speed: 90 mph
2. Exposure: C
3. Importance Factor: Iw = 1.15

D. Seismic Loads: The seismic lateral and vertical forces shall be calculated in accordance with the ASCE 7-05, Chapters 11 and 13, using the appropriate design parameters for the respective site location. Provide values for the following categories as part of the Seismic Submittal.

1. Site Class
2. Seismic Design Category (SDC)
3. Seismic Importance Factor:
   a. Short Period Spectral Acceleration

b. Second Period Spectral Acceleration

E. Hydrodynamic Forces: Hydrodynamic forces calculated in accordance with AWWA D100, API 650 or ACI 350.3-06 shall be based on the appropriate parameters for the respective site location. Provide values for the following categories as part of the Seismic Submittal.

1. Site Class
2. Seismic Design Category (SDC)
3. Seismic Importance Factor:
   a. Short Period Spectral Acceleration
   b. Second Period Spectral Acceleration

F. Anchors: Anchor bolts shall be in accordance with Section 05500 - Miscellaneous Metalwork, and shall be designed to resist the above loads. Anchor bolt calculations shall clearly show that the capacity of the anchor and the capacity of the concrete that the anchor is embedded in are adequate to resist all loads stated in the 2015 (or latest edition) IBC and ASCE 7-05, including lateral wind and lateral and vertical seismic loads. Reduction factors associated with edge distance embed length, and bolt spacing shall all be considered and based on the actual dimensions of the concrete that resists the anchorage forces. Anchor bolt details shall include required bolt diameter, embed, and edge distances. Further, the design of Anchors shall consider the ductility requirements stated in ASCE 7-05, Chapter 13, Section 13.4.2 and Chapter 15, Section 15.7.3. Anchor bolt calculations and details shall be submitted and shall bear the signature and seal of a Registered Professional Engineer licensed in the State of Utah.

G. Equipment Foundations: Mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 4-inch high concrete bases, unless otherwise indicated. Equipment foundations are indicated on Drawings. The CONTRACTOR, through the equipment manufacturer, shall verify the size and weight of equipment foundation to insure compatibility with equipment. The dimensions of all concrete bases shall be sufficient to provide the edge distances required by the anchor bolt calculations.

1.9 ACCESSIBILITY

A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.

B. Extend all grease fittings to an accessible location.

C. Establish required clearance to all installation features involving operation and maintenance. Respect manufacturer's recommendations for access and clearance.

D. Access Doors - General: All items of HVAC equipment which may require maintenance, replacement or which control a system function shall be made readily accessible to personnel operating the building.

1. Provide access doors in all ductwork or plenums as required to maintain filters, dampers, equipment, controls or other elements of the system. Doors shall be double wall, framed, hinged and provided with latches and shall conform to SMACNA standards, unless otherwise detailed or specified.

1.10 CHANGE ORDERS: See General Conditions.

1.11 ALTERNATIVE CONSTRUCTION/SUBSTITUTION: These documents outline a way in which the Owner may be delivered a functional and reliable facility. Drawings and specifications describe reasonable engineering practice for the Contractor to follow.

Coordination between trades may result in periodic needs to adjust the installation from that indicated, but in no case shall the intended function be compromised.

The Contractor may perceive some material or work methods which differ from those specified which could save time and effort without compromising quality. These may be presented to the Engineer with a breakdown of possible cost savings for review. Implement changes only with authorization.

Materials substitutions will generally be covered in a review process prior to bidding. After bidding, material or equipment substitutions shall be proposed only on the basis of definitive cost accounting and implemented only with authorization.

1.12 CUTTING AND PATCHING

A. Lay out the project where new work is involved ahead of time, providing sleeves and block outs, and have work specifically formed, poured and framed to accommodate HVAC installations. Cut and patch only as needed. Repair wall or floor where cutting and patching is needed to match existing.

B. Refer to Division 26 Section: ELECTRICAL GENERAL REQUIREMENTS for requirements for cutting and patching for electrical equipment, components, and materials.

C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other and any work damaged as a result of HVAC installations.

E. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.

F. Perform cutting, fitting, and patching of HVAC equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work;

2. Remove and replace defective Work;

3. Remove and replace Work not conforming to requirements of the Contract Documents;

4. Remove samples of installed Work as specified for testing:

5. Install equipment and materials in existing structures.

G. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.

H. Cut, remove and legally dispose of selected HVAC equipment, components, and materials as indicated, including, but not limited to removal of HVAC piping and other HVAC items made obsolete by the new Work.

I. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

J. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

1.13 SUBMITTALS: Submittal of shop drawings, product data, and samples will be accepted only from the Contractor to the Engineer. Submittal shall meet the requirements of section 01 30 00 – Submittals. Data submitted from subcontractors and material suppliers directly to the Engineer will not be processed. There is opportunity and allowance for discussion prior to submittal. Document each transmittal at each transfer level of the process, and sign and stamp the submittal indicating that it has been reviewed and is in compliance with the criteria of the project, any exceptions being clearly noted. Submittals are to include all supporting calculations for the equipment, supports and anchorage of the equipment.

A. SHOP DRAWINGS: As soon as possible after the contract is awarded, submit to the Engineer, an electronic copy of the descriptive literature covering all equipment and materials to be used in the installation of HVAC systems for this project. Obtain written confirmation of acceptable review by the Owner's Representative before ordering, purchasing, acquiring or installing any such equipment or materials for the project.

Prepare the submittals in an orderly manner after the order of this specification, with identification tabs for each item or group of related items. Clearly indicate performance, quality, utility requirements, dimensions of size, connection points and other information pertinent to effective review.

Equipment must fit into the available space with allowance for operation, maintenance, etc. The Contractor shall take full responsibility for space and utility requirements for equipment installed. Do not submit anything that will not fit or will not work.

Factory-wired equipment shall include shop drawings of all internal wiring to be furnished with unit.
Review by the Engineer will be for general conformance of the submitted equipment of the project specification; in no way does such approval relieve Contractor of his obligation to furnish equipment and materials that comply in detail to the specification, nor does it relieve the Contractor of his obligation to lay out ahead of time to determine actual field dimensions and conditions which may affect his work.

B. Record Drawings: See Division 1. During the course of construction, maintain a set of drawings, specifications, change orders, shop drawings, addenda, etc., for reference and upon which all deviations from the original layout are recorded. Turn these marked up documents over to the Engineer within 90 days of system acceptance so that the original tracings can be revised. If the Contractor fails to mark up the prints, he shall reimburse the Engineer for the time required to do so.

1.14 OPERATION AND MAINTENANCE TRAINING

A. Instruction of Owner's Personnel: At a time prior to Owner making use of a device or system, and in general after testing and balance work for a building or major system is complete, prepare, schedule and conduct a series of training sessions for Owner's operating and supervisory personnel. Instructions shall cover each device and system with emphasis on understanding of the purpose and function, the maintenance requirements and the proper adjustment and operating technique.

B. Instruct building operating staff in operation and maintenance of HVAC systems utilizing Operation and Maintenance Manual when so doing.

C. Contractor to video tape instruction sessions, and give video tape to owner.

D. Minimum instruction periods shall be as follows:

1. HVAC - 8 hours, or more as needed.

2. Temperature Control - 8 hours, or more. Programming help as needed. Coordinate with Divisions 26 and 40 for Instrumentation and HVAC control.

E. Initial instruction periods shall occur after pre-final inspection when systems are properly working and before final payment is made. Schedule subsequent visits with the Building Operation Personnel throughout the first year.

F. Vendors for each piece of equipment, controls, etc., shall participate along with the Contractor(s).

1.15 GUARANTEE/WARRANTY: The following guarantee is a part of this specification and is binding on the part of the Contractor and his assigns:

"Contractor guarantees that this installation is in accordance with the terms of the Contract and is free from HVAC defects. He agrees to replace or repair, to the satisfaction of the Owner's Representative, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance. See also the General Conditions of these specifications. Failed equipment in the repair or replacement shall be guaranteed for one full year from the date of "Substantial Completion."

Compile and assemble the warranties required by Division 23 into a separated set of vinyl covered, insert sheets, tabulated and indexed for each reference, included in the O & M Manual.

Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

HVAC systems and equipment shall not be considered for substantial completion and initiation of warranty until they have performed in service continuously without malfunction for at least thirty (30) working days.

1.16 TESTS AND CERTIFICATIONS: Make all tests required by code or specification in the presence of a representative of the Owner, with tests recorded and certified by the Contractor and Representative. Involve local authorities where required.

1.17 PERMITS, FEES, LICENSES: Refer to General Conditions.

1.18 CEILING SPACE AND OPEN SPACE COORDINATION: Carefully coordinate ceiling cavity and open space with all trades; however, installation of HVAC equipment within the ceiling cavity space allocation, in the event of conflict, shall be in the following order: process piping, cable tray plumbing waste lines; supply, return and exhaust ductwork; domestic hot and cold water; fire protection; control conduit. Respect clearances required for lights, electrical conduits, protected structure, etc. All spaces above any and all ceilings shall be defined and considered as return air plenum space.

1.19 HVAC RELATED CONTROLS AND INSTRUMENTATION

A. The Instrumentation and Controls for HVAC systems installed by this project are to be provided under Divisions 26 - Electrical and Division 40 – Process Interconnections but to be fully supported and complemented in a conventional way by providers of Sections 23 work. Extent of control systems work required by this section is indicated on drawings and schedules, and by requirements of this section.

1. See following sections for Control Systems and instrumentation requirements:

a. Section 26 05 00 – Electrical General Requirements

b. Section 40 10 00 – Process Control and Instrumentation System –General
c. Section 23 09 00 – HVAC Control Systems

2. Control sequences will be provided for Owner's programming. See Division 40.

B. Provide for installation of instrument wells, valve bodies, and dampers in mechanical HVAC systems.

C. Include Divisions 26 – Electrical and 40 – Instrumentation sections in the following work.

1. Power supply wiring from power source to power connection on controls and/or unit control panels. Includes starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

2. Interlock wiring between electrically operated equipment units; and between equipment and field installed control devices. Interlock wiring specified as factory installed is work of this section.

3. Control wiring between field installed equipment, controls, indicating devices, and unit control panels.

4. 24 volt and 120 volt service work required by instrumentation/control systems.

D. Participate in "System Commissioning, Testing and Balancing".

PART 2 – PRODUCTS

2.1 QUALITY AND CHARACTER OF MATERIALS AND EQUIPMENT:

A. New and conventional: All equipment and materials shall be new, and shall be the standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment, and shall be the manufacturer's latest design. Specific equipment shown in schedules on drawings and specified herein is to be the basis for the Contractor's bid. Provisions for substitute equipment are outlined in the General Conditions.

B. Complete: Furnish and install all major items of equipment herein specified and/or called out in the equipment schedules on the drawings complete with all accessories normally supplied with catalog items listed, and with all other accessories necessary for a complete and satisfactory installation.

C. Code Compliant: There are certain Code defined hazards associated with the Waste Water Treatment Plant environment, generally outlined in NFPA Standard 820. The Contractor in all if its entities should be familiar with the standard and provide installations which will be compliant in all regards. Of particular interest are the requirements where vagrant flammable process gases such as methane and hydrogen sulfide may develop. Such areas include the Wet Wells, Grinder Rooms and other similarly classified spaces where exhaust fans are involved to dilute the concentration of gases. All HVAC equipment involved in these areas must have an "explosion-proof" characteristic. Impose this requirement on all materials, motors, etc. provided by these Division 23 specifications.

2.2 PROTECTION OF MATERIALS AND EQUIPMENT:

A. Close pipe and duct openings with caps or plugs to prevent lodgement of dirt or trash during the course of installation. Cover equipment tightly and protect against dirt, water and chemical or HVAC injury. Plumbing fixtures intended for the final installation shall not be used by the construction forces. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly and deliver in a factory dock condition for the Owner's acceptance. Make damage and defects developing before acceptance of the work good at Contractor's expense.

B. Do not make temporary use of project equipment, during construction. DO NOT USE PERMANENT HVAC SYSTEMS FOR TEMPORARY HEAT!!

2.3 QUALIFICATIONS OF WORKMEN:

A. All mechanics shall be capable journeymen, skilled in the work assigned to them. Apprentices may be used with appropriate direction.

B. Do not employ unskilled persons in the work; execute all work in a skillful and workmanlike manner. All persons employed shall be competent, faithful, orderly and satisfactory to the Owner. Should the Owner's Representative deem anyone employed on the work incompetent or unfit for his duties, and so certify, Contractor shall remove that employee from this project and he shall not be again employed upon the project without permission of the Owner's Representative.

C. All welders involved in welding of pressure piping systems shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Written verification of successful test completion shall be submitted to Architect prior to initiating work.

2.4 FOREMAN: Designate an experienced and qualified general HVAC foreman for the project work to be consistently available on site during the life of the project for consultation. Do not replace this individual without prior approval from the Owner's Representative.

2.5 USE OF COMMON VENDORS: Regardless of subcontract delegations, coordinate purchasing between trades so that equipment and materials of similar nature come from a single vendor, i.e., all package HVAC units shall be common source. Valves, variable volume boxes, etc., the same. Do not burden the Owner with multiple brands of similar equipment unless so directed.

2.6 ROOF/WALL/FLOOR PENETRATIONS - FLASHINGS:

A. Install sleeves through the floor into dry rooms flush with the floor, caulked and sealed. Into wet rooms, extend piping above floor level to create 1" dam. Use Schedule 40 galvanized steel pipe for all pipe sleeves.

B. Let pipe sleeves allow for movement of the pipe due to expansion and contraction, yet to include seismic restraint.

C. Fire stopping: Provide fire stopping for all Division 23 penetrations of rated walls, floors, structure, etc. in conformance with ASTM E814 and with UL 1479.

D. Flashings:

1. Flash all equipment supports, pipes and conduit penetrating the roof. Provide required flashing components. See drawings or Architect/Engineer for additional detail.

2. Clamp roof drains to roof membrane, follow manufacturer's directions.

3. Make all ductwork penetrating a roof watertight with flashings, counter flashing and sealant. Provide curbs for any and all such openings.

2.7 EXCAVATING AND BACKFILLING (GENERAL): Reference, if required.

A. Provide all excavation, trenching and backfilling for HVAC underground duct and piping work. Excavation and backfilling shall comply with applicable paragraphs of Division 31. Tamp bottoms of trenches hard and, for soil and waste piping, grade to secure uniform fall of 1/4" per foot, or as noted. Excavate bell holes for hub and spigot pipes so that pipe rests on solid ground for its entire length. Lay sewer and water pipe in separate trenches, except where otherwise noted, as detailed.

B. After work has been tested, inspected and approved by the Owner's Representative and/or State/Local Inspector, and prior to backfilling, clean the excavation of all rubbish, and clean backfill materials free of trash. Place backfill in horizontal layers not exceeding 12" in thickness, properly moistened. Compact each layer with suitable equipment to a dry density of not less than 95 percent as determined by the Modified AASHO Test T-18O. See Division 31 for additional requirements.

1. Provide adequate shoring to safeguard workers from cave-ins for all excavations.

2. In areas where General Contractor has finish grade work to do, HVAC Contractor shall backfill and compact to 8" below finish grade. Where no finish surface work is to be done, HVAC Contractor shall backfill and compact to and match adjacent undisturbed surface with allowance for settling, etc.

3. Protect from damage all existing underground utilities or utility tunnels indicated on the contract drawings (or field located for the Contractor by the Owner prior to excavation operations). Any damage to identified existing utilities or utility tunnels shall be repaired by the Contractor at no cost to the Owner.

2.8 HANGERS AND SUPPORTS (GENERAL):

A. Provide mountings, hangers and/or supports for all HVAC equipment, piping and ductwork. Primary information is contained in these specifications as noted in, but not limited to, paragraph 1.8 above and on the drawings. Correlate HVAC work with the work of other trades to obtain a consistent manner of installation.

B. Provide hangers and supports to correlate with seismic restraint, expansion/contraction, and vibration isolation.

2.9 MANUFACTURER'S DIRECTIONS: Install all equipment in strict accordance with directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the plans and specifications, report such conflicts to the Engineer.

2.10 LUBRICATION: Lubricate equipment at startup. Then, provide all lubricants for the operation of all equipment until acceptance by the Owner. The Contractor is held responsible for all damage to equipment consequent to pre-acceptance operation.

2.11 ELECTRICAL WIRING AND CONTROL:

A. In general, primary motor starters, related motor starter equipment and power wiring indicated on the electrical drawings and control diagrams are to be furnished and installed under the Division 26 Specification. Items of electrical control equipment specifically mentioned to be furnished by the HVAC/Instrumentation (Controls) Contractor either in these specifications or on the related drawings, shall be obtained and mounted by this Contractor and shall be connected under and as required by specifications, all in compliance with the National Electric Code, and Divisions 26 and 40. Many control devices and fan motors are to be furnished and terminal block wired to a unit mounted power or control panel. The project requires this single location of connection for fan and pump motors, damper actuators, valve actuators, sensors smoke detectors and the like.

B. Refer to the control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the contractor.

C. HVAC electrical work must be fully coordinated with Division 26 to insure that all required components of the work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of coordination.

D. Where the detailed electrical work is not shown on the electrical drawings, the HVAC Contractor shall furnish, install and wire or have prewired all specified and necessary controls for package air equipment specified for this project. The objective of this paragraph is to make sure a complete operating system is obtained at no additional cost to the Owner for field wiring required related to the equipment.

2.12 FLUSHING AND DRAINING OF SYSTEMS/CLEANING OF PIPING AND DUCTS: Blow out all refrigerant piping systems with compressed air or nitrogen to remove foreign materials that may have been left or deposited in the piping system during its erection. Duct systems shall have all debris removed and fans shall be run to blow out all dust and foreign matter before outlets are installed and connected.

Damp wipe all ductwork on installation, cap open ducts, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

2.13 JOBSITE CLEANUP:

A. Keep site clean during progress of work.

B. At the conclusion of work, clean all installation thoroughly.

Leave equipment in a factory dock condition. Correct any damage and touch up or repaint if necessary.

Remove all debris from site.

END OF SECTION

SECTION 23 05 20
HVAC IDENTIFICATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-23 Basic HVAC Materials and Methods section apply to work of this section.

1.2 SUMMARY:

A. Label all heating, air conditioning, automatic temperature control equipment (excluding thermostats), and distribution systems. Also label all electrical switches and starters for all HVAC equipment.

PART 2 – GENERAL MECHANICAL MATERIAL AND METHODS

2.1 EQUIPMENT, PIPE AND DUCT IDENTIFICATION:

A. Equipment Identification:

1. Identify all equipment including, but not limited to, all mechanical equipment, ATC panels, controller, etc., and all other devices with signs made of laminated plastic with 1/8" or larger engraved letters.

2. Give each piece of equipment its own unique equipment number or symbol.

3. Information on sign shall include name of equipment, identification on plans and schedules, rating, maintenance instructions, and any other important data not included on factory attached name plate.

4. Signs shall be attached to equipment so they can be easily read. Attachment shall be by rust proof screws or rivets. Do not use adhesive.

5. Identification signs for equipment shall be similar to the following:

   a. Supply Fan (F-2)

      Rating: 49,850 cfm @ 3.5" s.p. (At 1600 ft. elevation)

      Maintenance: Check bearings for lubrication every 30 days and lubricate as required with S.A.E. 30 oil.

   b. “ATC Panel A”

2.2 PANEL IDENTIFICATION:

A. Provide all panel devices on panel faces with engraved black face Formica with white engraved lettering labels.

B. Provide all internal panel components with engraved black face Formica labels with white engraved lettering. Fasten label beneath each device.

C. Numerically or alphabetically code all panel wiring and tubing.

END OF SECTION

SECTION 23 05 30
HVAC OPERATION & MAINTENANCE MANUALS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

B. Division-23, Section 23 05 00 General HVAC Requirements sections apply to work of this section.

1.2 SUMMARY:

A. Furnish four sets of bound operation and maintenance (O&M) manuals within 90 days of system acceptance. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to operate, maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.

1.3 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL HVAC SYSTEMS:

A. General:

1. The "Operating and Maintenance Manual" is a bound compilation of drawings and data that the owner requires for each building or project. Furnish these manuals, complete with drawings and data, to the Owner through the Engineer.

2. The mechanical contractor has overall responsibility to obtain the necessary data from and compile the data as set forth in this specification.

3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.2A.

4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.

B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

PART 2 – MATERIALS AND METHODS

2.1 PAGE SIZE: All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 17 x 11 inches) folded to 8-1/2 x 11 inch.

2.2 DRAWINGS: All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders.

The equipment name, drawing description and number shall be written on the face of each manila pocket.

2.3 BINDERS: Binders shall be piano hinge, bar-lock type, Buckram (stiffened fabric cover) binders with block lettering for sheet size 8-1/2 x 11 inches with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, on not filling them beyond 4".

A. Place the following information on the front cover and backbone:

1. "Operation and Maintenance Manual".

2. Project Name (and volume number if more than one volume).
Project Number (Per owner's project number).

3. Building name and number.

4. Owner's name.

5. (Architect's name.)

6. Engineer's name.

7. General Contractor's name.

8. HVAC Contractor's name.

Items 5 through 7 need not be printed on the backbone.

2.4 CONTENTS AND INDEXING:

A. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.

B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.

C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:

1. 11 x 17 size project drawings in "As-built" condition.

2. Outline drawings, special construction details, "As built" electrical wiring and control diagrams for all major and supplementary systems.

3. Manufacturer's test or calculated performance data and certified test curves.

4. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.

5. Manufacturer's brochures marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included. Include performance data similar if not equivalent to the shop drawing submittal.

6. List the serial numbers of each item of equipment installed with the model numbers and plan symbols.

7. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:

Part I	Building and System Descriptions
Part II	Purchased Equipment Data
Part III	Test Reports and Valve Charts
Part IV	Start-Up and Operation
Part V	Preventative Maintenance Recommendations

8. A copy of the approved submittals for each piece of equipment.

9. A copy of all testing, adjusting and balancing reports.

10. Wiring diagrams, marked with model and size and plan symbol.

11. Operating and Maintenance Manuals data for Part I shall be obtained directly from the mechanical and electrical consultants. (Allow consultant preparation cost.)

12. The index for each section shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

PART 3 – EXECUTION

(Not Used)

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING & BALANCING

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

A. Work of this section shall be subject to the requirements of the General Conditions of this contract, the Mechanical - General Requirements, HVAC General Requirements, General Electrical Requirements and other sections where this work shares a responsibility.

B. System commissioning and startup of the HVAC systems shall be the responsibility of the HVAC Division 23 Contractor and his subcontractors with the participation of the Divisions 26/40 Electrical and Instrumentation Contractor(s) related to electrical and instrumentation work and the General Contractor related to general construction items.

C. Testing and balancing shall be under the direction of the General Contractor with the full participation of all of the mechanical and electrical trades employed on the project and shall include the participation of an independent testing and balance subcontractor to coordinate all elements of the work and to perform special technical services outlined herein.

1.2 SYSTEM COMMISSIONING - SCOPE OF WORK:

A. The work required under this section shall include but not necessarily be limited to the following:

1. The pre-startup inspection of all HVAC systems and subsequent correction of any incorrect items.
2. The initial first run inspections.
3. System operations inspection.

B. The intent of this section is to provide for proper installation, startup, service and operation of the mechanical systems in preparation for system balancing. See section for balancing of air system. After completion of the balancing, the mechanical system shall be ready for owner occupancy, with all systems operating as intended.

C. Repair, replacement or adjustment of each item shall be performed by the respective installing subcontractor.

1.3 TESTING AND BALANCING - SCOPE OF WORK:

A. This work incorporates a checkout of construction work, individual component activation and overall system activation into one work program which shall serve as the transition period from the Contractor's job to Owner's facility.

B. The Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.

C. The Contractor shall participate in the startup and shakedown of all mechanical systems installed and modified in this contract; test adjust and balance these systems to obtain optimum performance at a level which minimizes the required energy input, prepare and submit a complete report of work done and the final system condition obtained, participate in the instruction of Owner's personnel in the proper operation of systems and equipment.

1.4 QUALIFICATIONS OF SYSTEM COMMISSIONING AND TAB TEAM:

A. Representatives of Contractor shall be available on a daily basis through the commissioning and adjustment period. These men shall be experienced journeymen with prior experience in system operation and with specific experience on the construction of this project. Section 23 09 00 – HVAC Control Systems is a particular participant in the work.

B. Balancing shall be done at the Contractor's expense by an independent firm specializing in this work. A definition of independent shall mean the firm is not associated with any engineering, contracting, or manufacturing firm and derives its income solely from testing, adjusting and balancing mechanical systems. Approved firms to do this work include:

Bob's Test and Balance – Salt Lake City, UT
Certified Test and Balance – Salt Lake City, UT
Barnett, Inc. (Payson Sheet Metal) – Payson, UT

C. The balancing work shall be performed by the same firm having total professional responsibility for the final testing, adjusting and balancing of the entire system. A principal of the firm shall be directly involved in the project.

D. The testing and balancing firm shall furnish all necessary tools, scaffolding and ladders that are required and shall provide all required instruments, take all readings and make all necessary adjustments.

E. After all adjustments are made a detailed written report shall be prepared and submitted for approval, and shall bear the signature of the professional supervising the work. Final acceptance of this project will not be made until a satisfactory report is received. Furnish an electronic copy of the report for Engineer Review.

F. Treat each individual system as separate elements for reporting purposes.

PART 2 – EXECUTION, SYSTEM COMMISSIONING

2.1 PRE-STARTUP INSPECTION:

A. The pre-startup inspection of all systems shall provide for verifying that each piece of equipment is properly installed and prepared for startup.

B. All pertinent items shall be checked, including but not necessarily limited to the following:

1. Removal of shipping stops.
2. Vibration isolators properly aligned and adjusted.
3. Flexible connections properly aligned.
4. Belts properly adjusted.
5. Belt guards and safety shields in place.
6. Safety controls, safety valves and high or low limits in operation.
7. Filters in place and seal provided around edges.
8. All test stations and measuring devices installed.
9. Initial lubrication of equipment is complete.
10. Filters are clean.
11. Motor rotations are correct.
12. Voltages match nameplate.
13. Control system is in operation.
14. All interlocks are wired and verified.
15. All controls have been connected and verified.
16. All dampers and operators are properly installed and operating.
17. All ductwork is installed and connected.
18. All other items necessary to provide for proper startup.

C. Correct all incomplete or defective items.

2.2 FIRST RUN INSPECTION:

A. Recheck all items outlined in pre-startup inspection to insure proper operation.

B. Check the following items:

1. Excessive vibration or noise.
2. Loose components.
3. Initial control settings.
4. Motor amperages.
5. Heat buildup in motors, bearings, etc.
6. Control system is properly calibrated and functioning as required.

C. Correct all items which are not operating properly.

2.3 SYSTEM OPERATION INSPECTION:

A. Observe the mechanical systems under operating conditions for sufficient time to verify proper operation under varying conditions, such as day-night and heating-cooling.

B. Periodically check the following items:

1. Filters.
2. Visual checks of air flow for "best guess" settings for preparation for system air balancing under section applying.
3. Control operation, on-off sequences, system cycling, etc.
4. Visual checks of seals, packings, operation pressures.
5. Cleaning of excessive oil or grease.
6. Dampers close tightly.
7. All other items pertaining to the proper operation of the mechanical system whether specifically listed or not.

PART 3 – EXECUTION – TESTING AND BALANCING

3.1 TOTAL MECHANICAL SYSTEM BALANCE:

A. The mechanical systems consist of many elements. Total system balance requires that all elements be not only individually correct, but also correct as a composite system. Therefore, participation of all parties is required in the test and balance procedure.

B. Prior to beginning work, submit a written description of the anticipated sequence of action to the Engineer for review and comment.

C. The testing and balance specialist shall review the contract drawings during the bid period and shall advise the Engineer of any modifications to the layout which he might suggest to facilitate the balance procedure. Modifications will be incorporated into the contract by Addendum during the bidding period.

D. The test and balance specialist shall visit the project from time to time during the rough installation making a thorough inspection of those items which will affect his subsequent work. He shall advise the Contractor in writing with a copy to the Engineer of any work required by the contract which is not being performed adequately. This is in addition to the regular review efforts of the Engineer.

3.2 AIR SYSTEMS BALANCE:

A. Before any adjustments are made, the systems shall be checked for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc. All fan systems are to be adjusted to deliver design air quantities within +5%. Design static pressure is based on filters approximately 50% loaded with dirt. Pressure drop across filters during balancing shall be simulated to that condition. After balancing is completed, check motor amperage with the filters clean.

B. Adjust exhaust air systems for air quantities shown on drawings and the proper relationship between supply and exhaust established.

C. Exchange sheaves and/or belts as needed to adjust the RPM of all fans so they handle specified air quantity.

1. Determine the sheave on supply fans so that the VFD driven fan will deliver not less than 100% cfm with fully loaded filters.

2. Determine the sheave on the exhaust fans so that the VFD driven fan will fully load the motor at design cfm and 100% speed.

D. Verify the proper operation of all air side related control functions.

3.3 MAJOR EQUIPMENT:

A. The Testing and Balancing subcontractor shall work with the Instrumentation/Controls Contractor, Owners technical staff, and Electrician in placing new fans, and other major equipment in operation. The factory representative of the equipment manufacturer shall also participate in a team effort to place this system(s) in all anticipated operating modes and make adjustments as required to obtain correct operation. The Project Engineer shall witness the final operating sequence.

3.4 INSTRUMENTATION/CONTROL SYSTEMS:

A. The Testing and Balancing Contractor shall go through the entire HVAC portion of the PLC based instrumentation and control system with the Instrumentation Contractor and Owner's technical staff, verifying proper operation of each and every device and the proper function of each system. The report shall indicate and certify such effort.

3.5 MISCELLANEOUS:

A. Observe all furnished thermal overload protection and note such in the data sheets. If thermal overload protection is incorrect, it shall be the responsibility of the trade or vendor which furnished the overload devices to furnish and install the correct size overload protection devices, and it is the responsibility of the balancing firm to verify that proper overload protection has been installed at the completion of the job.

B. The adjusting crew shall measure and set any special conditions such as minimum air quantities; coordinate outside air, return air and relief air damper operation; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in "REPORT" below.

C. When deemed necessary, take 24-hour space temperature recording and any required partial rebalance of the system shall be performed without additional cost. Successful function supercedes nominal settings in order of importance.

3.6 REPORT:

A. Provide a bound report in four copies which shall contain a general information sheet listing instruments used, method of balancing, altitude correction, and manufacturer's grille, register and diffuser data.

B. Provide equipment data sheets listing make, size, serial number, rating, etc., of all mechanical equipment including fans, motors, starters and drives. Operating data shall include rotational speed, pressure drop across filters, coils, and other system components and measured motor current and voltage.

C. Reports shall contain a reduced set of contract drawings with outlets marked thereon for easy identification of the nomenclature used in the data sheets.

D. The report shall contain any abnormal or notable conditions not covered in the above.

E. Keep and submit a copy of a daily log of all work performed with a list of work scheduled for the day and the workers on the job.

END OF SECTION

SECTION 23 06 03
SUPPORTING DEVICES FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

B. This section is a Division-23 Basic HVAC Materials and Methods section, and is part of each Division-23 HVAC section making reference to supports and anchors specified herein.

C. This section heavily references Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) manuals of standard practices.

1.2 SUMMARY:

A. Extent of supports and anchors described by this section is generally indicated on drawings and/or specified in other Division-23 HVAC sections. Much support and anchorage is implied in that all HVAC installation, piping, ductwork, equipment and specialties require support and restraint. Correlate this section with Section 23 06 05 related to sound, vibration and seismic restraint.

B. Types of supports and anchors specified in this section include the following:

1. Hanger-Rod Attachments.
2. Building Attachments.
3. Saddles and Shields.
4. Miscellaneous Materials.
5. Anchors.
6. Equipment Supports.

C. Supports and anchors furnished as part of factory-fabricated equipment are specified or presumed as part of equipment assembly.

D. Relate this section to Section 23 06 05 regarding seismic and vibration control.

1.3 QUALITY ASSURANCE:

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. Typical vendors of support systems include Grinnell.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.

B. Shop Drawings:

1. Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor.

Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division-1.

1.5 REFERENCES:

A. Codes and Standards:

1. Code Compliance: Comply with applicable building, mechanical and plumbing codes pertaining to product materials and installation of supports and anchors.

2. UL and FM Compliance: Provide products which are UL-listed and FM approved.

3. MSS Standard Compliance:

Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

Select and apply pipe hangers and supports, complying with MSS SP-69.

Fabricate and install pipe hangers and supports, complying with MSS SP-89.

Terminology used in this section is defined in MSS SP-90.

PART 2 – PRODUCTS

2.1 HANGER-ROD ATTACHMENTS:

A. General: Except as otherwise indicated, provide factory- fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

B. Steel Turnbuckles: MSS Type 13. (For adjustment up to 6" for heavy loads.)

C. Steel Clevises: MSS Type 14. (For use on high temperature piping installations.)

D. Swivel Turnbuckles: MSS Type 15. (For use with split pipe rings, MSS type 11.)

E. Malleable Iron Sockets: MSS Type 16. (For attaching hanger rod to various types of building attachments.)

2.2 BUILDING ATTACHMENTS:

A. General: Except as otherwise indicated, provide factory- fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

B. Concrete Inserts: MSS Type 18. (For upper attachment for suspending pipe hangers from concrete ceiling.)

C. Top Beam C-Clamp: MSS Type 19. (Use under roof installations with bar joist construction, for attachment to top flange of structural shape.)

D. Side Beam or Channel Clamps: MSS Type 20. (For attachment to bottom flange of beams, channels, or angles.)

E. Center Beam Clamps: MSS Type 21. (For attachment to center of bottom flange of beams.)

F. Welded Beam Attachments: MSS Type 22. (For attachment to bottom of beams where loads are considerable and rod sizes are large.)

G. C-Clamps: MS Type 23. (For attachment to structural shapes.)

H. Top Beam Clamps: MSS Type 25. (For attachment to top of beams when hanger rod is required tangent to edge of flange.)

I. Side Beam Clamps: MSS Type 27. (For attachment to bottom of steel I-beams.)

J. Steel Beam Clamps with Eye Nut: MSS Type 28. (Same as Type 28 with link extensions.)

K. Linked Steel Clamps with Eye Nut: MSS Type 29. (Same as Type 28 with link extensions.)

L. Malleable Beam Clamps: MSS Type 30. (For attachment to structural steel.)

M. Steel Brackets: One of the following for indicated loading:

1. Light Duty: MSS Type 31, to 570 pounds.

2. Medium Duty: MSS Type 32, to 1,500 pounds.

3. Heavy Duty: MSS Type 33, to 3,000 pounds.

N. Side Beam Brackets: MSS Type 34. (For use on sides of steel or wooden beams.)

O. Plate Lugs: MSS Type 57. (For attachment to steel beams where flexibility at the beam is desired.)

P. Horizontal Travelers: MSS Type 58. (For supporting piping systems subject to linear horizontal movements where head room is limited.

2.3 MANUFACTURERS OF HANGERS AND SUPPORTS:

A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:

1. Kin-Line, Inc.
2. Fee & Mason Mfg. Co.; Div. Figgie International
3. ITT Grinnel Corp.
4. B-Line
5. Unistrut

2.4 OUTSIDE AREAS: Use galvanized hangers, attachments, rods, nuts, bolts, and other accessories for all

outside areas.

2.5 MISCELLANEOUS MATERIALS:

A. Metal Framing: Provide products complying with NEMA STD ML 1.

B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.

C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration. Use Embeco or Engineer approved equal grout for non-shrink applications.

D. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

E. Pipe Guides: Provide factory-fabricated guides, of cast semi- steel or heavy fabricated steel, consisting of bolted two- section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

PART 3 – EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 PREPARATION:

A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.3 INSTALLATION OF BUILDING ATTACHMENTS:

A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms.

Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through the openings at the tops of inserts.

3.4 INSTALLATION OF HANGERS AND SUPPORTS:

A. General: Install hangers, supports, clamps and attachments to rigidly support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

C. Prevent electrolysis in support of copper tubing by the use of hangers and supports which are copper plated, or by isolating with foam rubber covering or 30 mil insulating tape.

D. Provisions for Movement:

Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

Install supports within 2 feet of non-vertical flex connectors

E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Insulated Piping: Do not allow hangers to come in contact with pipe where pipe is specified to be insulated.

H. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

I. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install galvanized steel protective shields. Install calcium silicate blocks (12" long minimum) at support points.

J. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

3.5 INSTALLATION OF ANCHORS:

A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer for loading and stresses to connected equipment.

B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.6 EQUIPMENT SUPPORTS:

A. Concrete curbs for exterior mounted HVAC equipment shall be provided by the General Contractor. Anchor to curbs provided. Provide weather tight seal.

B. Provide structural steel supports for equipment not floor or wall mounted. Construct of structural steel members or steel pipe and fittings.

3.6 ADJUSTING AND CLEANING:

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 06 05
MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

This section is a Division-23 Basic HVAC Materials and Methods section, and is part of each Division-23 HVAC section making reference to pipes and pipe fittings specified herein.

1.2 SUMMARY: Furnish and install complete support, restraint and vibration control systems for all work installed under Division 23 HVAC sections. Work to be responsive to the intent of the International Building Code, latest adopted edition, for the respective seismic zone. Correlate this work with 23 06 03 related to general supports of Mechanical / HVAC systems and equipment.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Engage the services of an independent support, restraint and vibration control subcontractor who has the technology, the experience, computer capabilities and manufactured products to prepare the required computations, shop drawings and special devices to meet the minimum requirements described herein.

The support, restraint and vibration control subcontractor shall visit the site during construction at a minimum of two specific periods.

1. When equipment is set in place, prior to placement of seismic restraint devices for the purposes of directing the contractor in properly locating and installing the approved devices.

2. At the completion of the project, prior to final mechanical inspection, for the purpose of verifying the correctness of the support, restraint and vibration isolation device installation and preparing certification of the vibration-isolation work.

The support, restraint, vibration control subcontractor shall exercise the quality control for this work and shall include, but not be limited to instructions direct to the Mechanical (Division-23 and Division-33) Contractor concerning:

Anchoring of all mechanical equipment.

Vibration mounting of equipment.

Equipment base coordination with restraint requirements.

Snubbing of equipment.

Bracing and anchoring of ductwork, piping and conduit.

Provision for vibration of piping.

Concrete and/or steel pads or bases to assure proper mounting of restraints and isolators.

Vibration isolation of exhaust fans, ventilation fans, other rotating equipment.

The subcontractor shall be responsible for identifying the need for the size and location of steel sole plates and their attachment to structural steel or concrete.

The subcontractor shall certify in writing that he has inspected the installation and that all isolation, anchors and seismic restraint materials are installed correctly and functioning properly. Certification shall be provided after all corrective work has been completed.

1.4 SUBMITTALS: Submittal data is required and shall consist of computations, vibration isolation selection, equipment anchors, anchor bolt sizes, supports, seismic restraints, sole plate data, restraint locations and type of restraints.

Submittal data shall identify dimensions, load deflection data, center of gravity, standard connections, manufacturer's recommendations, behavior problems including vibrations, thermal expansion, building expansion joints, etc., associated with equipment, ductwork, piping and conduit.

Calculations need not be submitted when restraint devices for piping, conduit and ductwork are proposed in accordance with the SMACNA Guidelines for Seismic Restraints.

Selection of isolator anchors and restraints shall be clearly made known along with the basis for selection so that proposed systems can be reviewed.

Calculations furnished for anchors, anchor bolts, sole plates and other support steel for restraining devices shall be signed and stamped by an engineer licensed in the State of Utah.

1.5 REFERENCES:

A. Codes and Standards:

International Building Codes	Latest Adopted Edition
NFPA bulletin 90A,	Latest Adopted Edition
UL Standard 181	Latest Adopted Edition
National Electric Code	Latest Adopted Edition

Guidelines for seismic restraint of Mechanical Systems and Plumbing Piping Systems. Published by the Sheet Metal Industry Fund of Los Angeles, California, and the Plumbing and Piping Industry Council, Inc., Los Angeles, California.

PART 2 - PRODUCTS

2.1 **MATERIALS - PRODUCTS**: Restraint devices shall be especially designed to resist system induced forces in all directions.

A. Snubbers: Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer neoprene (bridge bearing neoprene) to protect equipment. Restraints shall allow a maximum of 1/4" before engaging and shall not interfere in normal starting or stopping operation. Housing shall allow for visual inspection to determine clearances during system operation. Restraints shall be field adjustable and be positioned for up to 1/4" clearance both horizontally and vertically. Mountings and snubbers are to be manufactured under a Quality Assurance (QA) Program.

B. Snubbers and Isolator Combination Devices: Combination unitized devices may be used where equipment isolation is required. They shall include the requirements listed for snubbers. Isolation portion shall be stable spring type with combination leveling bolt and equipment fastening device. Base plate shall have adequate means for bolting to structure. The spring assembly shall be removable and shall fit within a welded steel enclosure.

C. Piping, Conduit and Duct Restraints: Restraint materials for exposed installation shall be standard fabricated flat steel, angle rod and channel members.
Restraint members shall be bolt connected. Cabling materials and methods shall be used only in

chases or concealed ceiling spaces.

PART 3 – EXECUTION

3.1 RESTRAINT GUIDELINE:

Guidelines for SMACNA seismic restraints for conduit, piping and ductwork are to serve as the basis for restraint methods. (Exception – Use rigid member bracing and attachment concepts. No cabling shall be used in the restraint systems except as noted.)

3.2 SEISMIC RESTRAINT - DUCTWORK: Ductwork, four feet square and larger in cross sectional area or 26" diameter and larger shall be protected in all places by restraints. Locations shall include, but not be limited to:

A. At all equipment connections.

B. At all duct turns and duct run ends (transverse bracing).

C. Transverse bracing to occur 30'-0" O.C. maximum. Rectangular ducts 61" and larger in either direction may be braced at 32'-0" O.C.

D. Longitudinal bracing shall occur at 60'-0" O.C. maximum.

A group of ducts may be combined in a larger size frame using the overall dimensions with maximum weight for selection of restraint members.

No bracing is required if the top of the duct is suspended 12" or less from supporting member and attached to the top of the duct.

3.3 VIBRATION ISOLATION:

A. General: Furnish and install devices to isolate moving equipment from the structure. (Or confirm that equipment may be securely fastened directly to the structure without negative effect.) Review isolation furnished with factory package equipment, require conformance with project criteria.

B. Basic Criteria: Vibration isolation devices which have natural frequencies approximately 1/10 that of the related driving frequency.

C. Equipment to Include:

1. Exhaust Fans:

a. Field Verify: All required devices and installation.

3.4 VIBRATION ISOLATION - DUCTWORK AND PIPING:

A. Furnish and install devices to isolate all piping and ductwork from other moving equipment. Provide flex connections, spring hangers, grooved joint couplings for pipe, etc., as required.

END OF SECTION

SECTION 23 06 07
MOTORS, DRIVES & ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division-26 and Division-40.

C. Reference 26 29 23 for description related to Variable Frequency Drives (VFD)'s. All Variable Frequency Drives shall be furnished by Division 26.

1.2 SUMMARY:

A. This section specifies the basic requirements for motors furnished by Division-23 HVAC and for electrical components which are an integral part of packaged HVAC equipment. Package components include, but are not limited to factory installed motors, starters, and disconnect switches, etc.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for HVAC equipment are noted within these documents.

1.3 QUALITY ASSURANCE:

A. For items with electrical aspects furnished by this Division and these Sections, provide electrical components and materials which are UL labeled and assembled with U.L. listings.

1.4 SUBMITTALS:

A. Submit product data for motors, belts, drives, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections. Verify project electrical characteristics with submittal. Confirm suitability for altitude, maintaining full nameplate rating plus service factor. Include this data in maintenance manual in accordance with 23 05 30 "HVAC Operation and Maintenance Manuals".

1.5 REFERENCES:

A. NEMA Standards MG 1: Motors and Generators.

B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.

C. NEMA Standards 250: Enclosures for Electrical Equipment.

D. NEMA Standards KS 1: Enclosed Switches.

E. IEEE Standard 519: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

F. Comply with National Electrical Code (NFPA 70).

PART 2 - PRODUCTS

2.1 MOTORS: See 26 05 74 “Electric Motors” but not less than the following:

A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are given in the individual equipment specifications.

1. Torque characteristics shall be sufficient to satisfactorily accelerate and maintain the driven loads.

2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.

3. Provide two-speed motors with two separate windings for poly-phase motors. Confirm 2-speed starter requirements with Division-26.

4. Fraction Horsepower Single speed motors shall be of the permanent split capacitor type. (PSC)

5. Temperature Rating: Minimum rate for 40°C environment with maximum 90°C temperature rise for continuous duty at full load (Class H Insulation for altitude, Class B leads allowed).

6. Starting Capability: Capable of handling not less than 6 evenly timed/spaced starts per hour, (10 minute cycle time) or more as indicated by the automatic control system,

7. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors, 1.0 for TEFC motors.

8. Motor Construction: NEMA Standard MG 1, TEFC, continuous duty, design "B", except design "C" where required for high starting torque. Provide motors rated for “Inverter duty” where motors are fed power from variable frequency drives.

9. Motor Frames: NEMA Standard No. 48 or 54; T-frame, use driven equipment manufacturer's standards to suit specific application.

10. Bearings:

    a. Ball or roller bearings with inner and outer shaft seals. Provide with electrically isolated bearings when the motor is fed power from a variable frequency drive.
    b. Re-greasable with zerk fittings, except permanently sealed where motor is normally inaccessible for regular maintenance;
    c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust on motor;
    d. For fractional horsepower, light duty motors, sleeve type bearings are permitted;

11. Enclosure Type: Totally enclosed fan cooled (TEFC) for wet or harsh/dirty environments. Typical throughout this project. Explosion proof (EP) rating for all installation in hazardous locations.

12. Overload Protection: Provide motors with built-in thermal overload protection. Where indicated for industrial motor applications, Provide motors with an internal sensing device suitable for signaling and stopping motor at starter.

13 Noise Rating: "Quiet"

14. Efficiency: "Premium Energy Efficient" motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112. Motors used with Variable Frequency Drives shall be compatible and designed for use with Variable Frequency Drives. Any “explosion proof” motor set in a classified area and scheduled for use with a variable frequency drive shall be listed for inverter duty applications.

15. Nameplate: indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

16. Acceptable Manufacturers: Allis-Chalmers, Baldor, Century, General Electric, Gould, Lincoln, Louis-Allis, Marathon, Reliance, U.S. Motors, Westinghouse.

2.2 MOTOR DRIVES:

A. Provide fan/motor-compressor/motor drives with cast steel sheaves and V-belts of fabric and rubber construction by Browning, Dodge, or Woods. Match multiple belts and adjust the assembly to properly drive the apparatus and to prevent slippage and undue wear in starting. Design drives for 150 percent or more of the specified motor nameplate rating. Furnish all drives with shaft bushings. Belts shall be A, B or C section belts. Narrow gauge belts are not acceptable. Provide adjustable driver sheaves for motors five horsepower and smaller, adjust drives or replace sheaves (on larger motors) as needed to obtain required driven speeds and system capacities.

B. Provide shaft to shaft coupled drives for pumps and blowers equivalent to the Dodge “Paraflex” design by Browning, Dodge or Woods.

C. Provide a removable (for maintenance) galvanized steel guard for each V-belt drive, coupled drive or rotating shaft constructed around an angle iron frame, securely bolted to the floor or apparatus. Design the guard to completely enclose drives and pulleys and be constructed to comply with all safety requirements. Provide hinged access doors not less than 6" x 6" for access to motor and fan shaft for test purposes. For double inlet fans, construct the belt guard cover of 1/2" mesh expanded metal, arranged as not to restrict the air flow into the fan inlet.

2.3 VARIABLE FREQUENCY DRIVES: Reference 26 29 23.

END OF SECTION

SECTION 23 09 00
HVAC CONTROL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-23, Section 23 05 00 - General HVAC Requirements sections apply to work of this section.

C. Division 40 is responsible for the overall instrumentation and control work for the exhaust fans. The HVAC systems are supportive of, but in many ways are independent of the fundamental process control aspects of the project. This section is an integration of the HVAC work into the overall plant instrumentation and control system.

1.2 SUMMARY:

A. Extent of control systems work required by this section is indicated on "H" drawings and schedules, and by requirements of this section.

1. This work has a multi-faceted HVAC Controls responsibility.

a. Provide Local Control Panels (LCPs) as described below to manage and control the HVAC devices and systems.

b. Controls for the stand alone HVAC related systems is to be provided by the Division 23 HVAC controls contractor using components described in this Section.

2. Follow control sequences as described in these documents. It is common for sequences and set points to require adjustment in the field to accommodate the final character of overall assemblies. Allow time to make adaptations and adjustments as needed. System setups are often seasonally variable. Re-visit the operation at least four times during the first year to make sure that the functions of the systems are being satisfied.

3. During the bidding period, thoroughly review the documents and request clarification of insufficient, ambiguous or contradictory presentation. The fundamental assumption is that there is a duty to be met and that the documents require as a minimum that devices, materials and installation will be provided to result in fully coherent and functional systems. Provide devices with any and all optional features required to obtain required function. Provide devices of materials that are compatible with the plant environment.

B. Refer to other Section 23 31 10 – “Ductwork Accessories” for installation dampers in mechanical systems.

C. Refer to Division-26 sections for the following work.

1. Interlock wiring between electrically-operated equipment units; and between equipment and field-installed control devices.

a. Interlock wiring specified as factory-installed is work of this section.

D. Provide all field electrical work complying with and as work of the Division-26 sections.

1. Control wiring between field-installed equipment, controls, indicating devices, and unit control panels.

2. 120 volt service required by instrumentation and control systems.

E. Participate in Section 23 05 93 "Testing, Adjusting and Balancing".

1.3 QUALITY ASSURANCE:

A. MANUFACTURER'S QUALIFICATIONS: Firms regularly engaged in manufacture of instrumentation and electric control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. INSTALLER'S QUALIFICATIONS: Firms and workmen specializing and experienced in programmable logic control, pneumatic and electric control system installations for not less than 5 years. Installer shall be under the direction of the instrumentation subcontractor and able to act as an authorized agent thereof.

1.4 SUBMITTALS:

A. PRODUCT DATA: Submit manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions. Confirm that devices offered are suitable for the indicated duty, inherently hardened against the adverse environment of the wastewater treatment plant. Note that exposed copper and copper bearing materials (i.e. bronze) are inappropriate for this duty. Provide devices of stainless steel, etc.

B. SHOP DRAWINGS: Submit material catalog sheets and shop drawings for each control system, containing the following information:

1. Schematic flow diagram of system showing, but not limited to, fans, unit heaters, coils, dampers and control devices, etc.

2. Label each control device with final designated setting or adjustable range of

control.

3. Indicate all required tubing and/or electrical wiring. Clearly differentiate between portions of work that are factory-installed and portions to be field-installed. Note contract responsibility to provide complete system regardless of delegation. Completely interface with and show existing installation in the existing building.

4. Provide details of faces of control panels, including controls, instruments, and labeling.

5. Include verbal written description of sequence of operation. Confirm correct function of proposed sequences.

C. SAMPLES: Submit sample of each type of proposed thermostat cover.

D. MAINTENANCE DATA: Submit maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Section 23 05 93.

1.5 REFERENCES:

A. CODES AND STANDARDS:

1. Electrical Standards: Provide electrical products which have been tested, listed and labeled by UL and comply with NEMA standards.

2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric control systems.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

4. Comply with NEPA 70, "National Electric Code" for all electrical installation.

1.6 DELIVERY, STORAGE, AND HANDLING: Provide factory shipping cartons for each piece of equipment, and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protected from weather.

1.7 INSTRUCTION OF OWNER'S PERSONNEL: (See Section 23 05 00)

A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.

B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.

C. Prepare an outline of information to be conveyed, list materials available for reference. Submit to Engineer along with a proposed schedule of instruction. Schedule to allow individual time for each trade and each system.

D. Convey information in formal classroom session. Teachers to include qualified contractor personnel and sales representatives for each major piece of equipment. Go from the classroom to the actual location to graphically illustrate concepts discussed.

1.8 WARRANTIES:

A. As part of the overall project warranty, furnish individual manufacturer warranties for each piece of equipment for a period of not less than one year from date of Owner's beneficial use (substantial completion not date of delivery).

B. Warrant the overall assembly of equipment, materials and labor comprising these systems.

1.9 CLEANING AND LUBRICATION: All instruments, control panel and control piping shall be thoroughly cleaned before final acceptance. Provide lubrication for all furnished equipment.

1.10 TESTING AND ADJUSTING OF SYSTEM:

A. During the system commissioning, testing and balancing of the various building systems, have a controls representative(s) present and available to interpret and adjust controls as needed. Demonstrate and report the integrity and accuracy of each function and control point.

B. At the termination of the testing period, the Controls representative shall spend one working day instructing the Owner's operating personnel in the control system operation, and one working day checking each system for day-night and manual override with the Owner's operating personnel on each air handling system. A complete operating booklet shall be provided and used during the training period. Schedule this training with the Owner and Mechanical Contractor.

Since system performance is partly a function of climatic conditions, the Controls contractor shall be available during the changing seasons of the warranty period to make further adjustments and modifications if required. A final complete check of all systems shall be made at the conclusion of the one year warranty period.

PART 2 - PRODUCTS

2.1 ROOM THERMOSTATS:

A. The thermostats and controllers for the Unit Heaters shall be furnished by the respective vendors. Coordinate field wiring requirements with each vendor's installation instructions manual.

2.2 AUXILIARY RELAYS:

A. Light Duty - as required. (verify current model number)

B. Heavy Duty - Square D, Class 8501, Type X. (For motor control)

2.3 ACCESSORIES

A. Provide devices with all components needed to make a complete and functional installation.

2.4 SOURCE QUALITY CONTROL

A Factory-calibrate each instrument according to manufacturer's standard at a facility that is traceable to the NIST.

B. Provide complete documentation covering the traceability of all calibration instruments.

2.5 HVAC CONTROL DAMPERS:

A. In supplying dampers, vendor shall instruct workers in the proper installation of the dampers. Ductwork shall be reinforced and the damper properly supported at the point of insertion without strain. In mounting dampers at a wall, provide clearance for the damper actuator and linkages. Make the damper installation airtight in terms of the air flow path.

B. Protect all dampers with a phenolic epoxy powder coating.

C. Provide damper operators with motors of proper size, so that the motors will operate against the static pressure of the systems. Provide each damper motor with a bracket for attaching to ductwork, building structure or equivalent. Damper motors in plenums shall be rigidly mounted on damper frames. Do not install motors in ducts. Modulating motors shall be provided with end switches and with integral stops for both minimum and maximum stop. Voltage ranges or pressure ranges shall be adjustable, the equivalent of pilot positioning for pneumatic or electric functions.

D. Control dampers for handling of outside air, relief air, exhaust air, ventilating air and other dampers exposed to weather temperatures in built-up or factory assembled systems: shall be low leakage type with spring loaded side seals, inflatable butyl or neoprene fabric edge seals, sleeve type bearings of stainless steel, nylon or Teflon, reinforced extruded blades. Parallel or opposed action or a combination thereof. Air leakage not to exceed 6 CFM per square foot at 4" upstream static pressure.

E. Provide dampers equivalent to Ruskin CD-403 (3”), CD-40 (4"), CD-50 (6")

F. Provide actuators for control dampers with not less that 33% excess torque capacity over and above the minimum needed to drive a given damper, load at not more than 5 inch-lbs per square foot of damper, more if damper requires. Actuators shall be configured for the duty, typically modulating, explosion proof for rated areas, manual over-ride, dual end switches, 24 volt or 120 volt drive as indicated, on board choice of 2 – 10 volt DC or 4 – 20ma signal input, mounting bracket assemblies, jack shafting and adapters as needed.

G. Provide actuators equivalent to Belimo AF(SR).

PART 3 – CONTROL SEQUENCES AND EXECUTION

3.1 GENERAL:

A. Provide control systems to manage and manipulate mechanical equipment in a functional and energy conserving way.

B. Reference Division 40 for control sequences related to the exhaust fans under a separate contract.

3.2 ELECTRIC UNIT HEATER (UH-1):

A. Each electric unit heater cycles on its own controls to satisfy the heating set point temperature of 45°F (adj.) when activated by the local unit mounted thermostat. Electric Unit Heater UH-2 shall serve as backup heat source if the heat pumps cannot maintain the space temperature set point.

3.3 INLINE EXHAUST FAN (EF-1):

A. Reference Electrical drawings and specifications for exhaust fan control diagrams and sequences.

3.4 WALL MOUNTED A/C UNIT (WAC-1):

A. WAC-1 operates through its own internal controls based upon a signal from a wall-mounted remote programmable controller.

B. The remote programable controller is furnished with the unit and shall be capable of controlling the unit in cooling mode. The unit shall operate in full outside air economizer mode when the outdoor conditions permit as sensed by the unit logic board (outdoor temperature, humidity, and particulate level are monitored by the unit logic board). The remote controller is to be field programmed so that the system maintains a space temperature set point of 70°(adjustable) in cooling mode.

END OF SECTION

SECTION 23 31 00
DUCTWORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-23 Basic HVAC Materials and Methods Sections apply to work of this section.

1.2 SUMMARY:

A. Extent of metal and high density polypropylene ductwork is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork required for the project include the following:

1. Rectangular

C. Refer to Section 23 05 93 for system commissioning, testing and balancing.

D. Refer to Section 23 09 00 for mechanical controls and control dampers (HVAC related only).

E. Refer to Section 23 31 10 for ductwork accessories.

F. Refer to Section 23 37 00 for louvers.

G. Refer to Section 23 82 00 for power ventilators.

H. Refer to Section 23 90 00 for filters.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal and high density polypropylene ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal and high density polypropylene ductwork systems work similar to that required for project.

The installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

All workmen on the project shall carry Utah state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal and high density polypropylene ductwork materials and products.

B. Shop Drawings: Submit coordinated scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spacial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division-1.

D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division-1.

1.5 REFERENCES:

A. Codes and Standards:

1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.

2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.

3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems".

4. International Building Code/International Mechanical Code/equivalent Utah Codes: Comply with all sections pertaining to mechanical work.

B. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK - GENERAL:

A. Standards: All duct fabrications shall comply with standards and techniques detailed by SMACNA "Duct Construction Manuals" for the appropriate pressure class, and with the ASHRAE Handbook, HVAC Systems and Equipment, 2016 edition, Chapter 19, Duct Construction

2.2 SHEET METAL DUCTWORK:

A. General: For all rectangular ductwork and fittings construct/fabricate from aluminum, PVC coated galvanized steel or stainless steel. Contractor may choose between aluminum, PVC coated galvanized steel or stainless steel except where specifically directed on the drawings.

If using galvanized sheet steel, provide galvanized sheet steel complying with ASTM A 527, lock forming quality, with G 120 zinc coating in accordance with ASTM A 525; mill phosphatized for exposed locations.

If using stainless steel, fabricate of Type 304 SS or Type 316 SS stainless steel sheet complying with ASTM A-167 with all welded joints and seams. Provide polished No. 4 satin finish for all duct exposed to view, No. 1 finish elsewhere. Protect finished surfaces with mill applied adhesive protective paper through fabrication and installation.

If using aluminum ductwork, aluminum ductwork shall be constructed of 3003-H-14 aluminum using construction for nominal 4" SMACNA rated systems. Seal all transverse joints with duct cement.

B. Exposed Ductwork Materials: Provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting. Installation of exposed ductwork shall be laid out in advance and submitted for review. Ductwork shall be hung straight and uniform, points shall be true, and seams shall show continuity.

C. Note a special requirement for hangers and supports for process areas. Project rejects strap hangers for ductwork. Make angle, insert, or clamp attachment to structure and hang suspended duct with rod or angle iron verticals and angle, channel or Unistrut horizontals. Brace and restrain ductwork as for piping with rigid assemblies. Do not use a cabling system for such duty.

2.3 FITTINGS AND FABRICATION:

A. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15^{o} change of direction per section.

B. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width. Limit angular tapers to 30^{o} for contracting tapers and 20^{o} for expanding tapers.

C. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Duct Accessories' for accessory requirements.

D. Offset, transition, and adapt ductwork to structural obstacles and work of other trades in a coordinated effort. Layout work to avoid conflict with piping, etc. With review of conditions, teardrop around conflicting piping, lights, etc., all at no added cost to the project.

2.3 MISCELLANEOUS DUCTWORK MATERIALS:

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Duct Sealing Compound for metal ductwork: Use a U.L. listed, fiber reinforced, water based adhesive duct sealing compound by Foster, Hard cast, United-McGill, Nova, Miracle, 3M, Duct mate, Duro Dyne. Verify that the material is listed for use in a moist, corrosive environment compatible with duct material. Follow manufacturer's directions for joint cleaning and preparation; seal all duct and plenum joints prior to and during assembly. Use mastics that will not weep if the duct is warmed above room temperature.

PART 3 – EXECUTION

3.1 INSPECTION:

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF METAL DUCTWORK:

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true to shape and to prevent buckling. Support vertical ducts at every floor.

All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All of these changes, however, must be approved and installed as directed at project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering.

B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

D. Electrical Equipment Spaces: Except as indicated, do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures. Maintain clearances above of and in front of electrical panels.

E. Ducts at Structural and Architectural Penetrations: Where ducts are shown connecting to or passing through concrete, gypsum board, masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2-1/8" stainless steel angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Round high velocity ducts in vertical chases shall be supported with rolled angle rings. Close openings between duct and structure.

F. Cross Breaking: Rectangular sheet metal ducts shall be cross broken or rolled rib reinforced on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles; the center of cross break shall be of the required height to assure surfaces being rigid. Larger ducts shall include intermediate reinforcing angles or members to stiffen the panel faces.

G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

Related to final installation cleanliness, damp wipe all ductwork on installation. Cap open duct ends, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

3.4 HANGERS AND SUPPORTS FOR METAL DUCTWORK.

A. It is essential that all ducts shall be rigidly supported. Hangers for low velocity ducts up to 18" in width shall be placed on not more than 10' centers.

Low velocity ducts 19" through 35" in width and greater shall be supported on not more than 5' centers. Where vertical ducts pass through floors or roofs, heavy supporting angles shall be attached to ducts, and to structure. Angles shall be of sufficient size to support the ductwork rigidly and shall be placed on at least two sides of the duct.

B. For rectangular ducts 36" and greater in width, construct hangers with all-thread rods and aluminum channel, galvanized iron channel, or Unistrut sections, minimum dimension 2” x 2” x 1/8".

C. Ductwork Support Materials for ductwork in Process Areas: Provide 316 stainless steel fasteners, anchors, and rods, washers, nuts and provide 316 stainless steel or 6061-T6 aluminum alloy angles for support of ductwork in process areas. Do not use straps.

D. Supporting Dampers: Parallel and opposed blade motor operated dampers shall be supported by reinforcing the ductwork or sheet metal walls at the damper locations to carry the weight of the dampers and the force exerted on the dampers due to air pressure, or shall be supported independent of ductwork from the ceiling or floor, as conditions at the site determine.

3.5 CONNECTIONS: All duct joints, transverse and longitudinal, shall be made airtight by coating joints with duct sealing compound before joining, and then sealing the joint with one layer of "Glass Fab" reinforcing tape set in a coating of the compound. Tape and sealant shall not exceed a flame spread of 25 or a smoke development of 50.

3.6 WELDED JOINTS: Welded metal ductwork shall have either an angle or a piece of 1/8" steel bar behind each weld to allow lying of a neat and continuous bead.

3.7 FIELD QUALITY CONTROL:

A. Leakage Tests: After each duct system which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Air leaks which are in excess of that required to bubble the soap suds (that is, actually blow the suds away) shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. Repair leaks and repeat tests until total leakage conforms with Chart of Figure 4-1, Seal Class A, Leakage Class 3 for round/oval, 6 for rectangular.

B. Allow 24 hours for the HDPE ductwork sealant to cure after final assembly before testing the duct system. Additional curing time may be required in high ambient conditions.

3.8 EQUIPMENT CONNECTION:

A. General: Connect metal and high density polypropylene ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors where indicated.

3.9 ADJUSTING AND CLEANING:

A. Clean ductwork internally of dust and debris, as follows: With filters in place where applicable, operate the fans at full capacity to blow out dirt and debris from ducts. If it is not practical to use the main supply blower for this test, the ducts may be blown out in sections by a portable fan.

B. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

C. Balancing:

1. Refer to Section 23 05 93 section "Testing, Adjusting and Balancing" for air distribution balancing of metal or high density propylene ductwork; not work of this section. However, the Sheet Metal Contractor shall participate fully in this work. Seal any leaks in ductwork that become apparent in balancing process.

2. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor and his subcontractors shall make any changes necessary to obtain the specified conditions.

END OF SECTION

SECTION 23 31 05
FIBERGLASS REINFORCED PLASTIC DUCTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for a Fiberglass reinforced plastic (FRP) ductwork system.
   1. Ducts and fittings.
   2. Flexible connections.
   3. Expansion joints.
   4. Supports.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. RTP-1 - Reinforced Thermoset Plastic Corrosion-Resistant Equipment.

B. American Water Works Association (AWWA):
   1. M45 - Fiberglass Pipe Design.

C. ASTM International (ASTM):
   1. C582 - Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
   2. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   3. D2105 - Standard Test Method for Longitudinal Tensile Properties of Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Tube.
   4. D2344 - Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates.
   5. D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
   6. D2992 - Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings.
   7. D2996 - Standard Specification for Filament-Wound “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
   8. D3982 - Standard Specification for Contact Molded “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Ducts.
   9. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. National Fire Protection Association (NFPA):
   1. 91 - Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Particulate Solids.

E. National Institute of Standards and Technology (NIST):
   1. PS 15 - Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.

F. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data and installation instructions.

B. Shop drawings:
   1. Scaled ductwork layout.
      a. Size, joint types, horizontal dimensions, and elevations.
      b. Support locations.
      c. External stiffeners and expansion joints locations.
   2. Fabrication details.
   3. Support, flexible connections, and external stiffeners.
      a. Materials and configuration.

C. Calculations:
   1. Wall thickness calculations based upon design criteria.
   2. Stresses and reaction loads at supports.

D. Manufacturer's installation instructions.
   1. Detailed instructions for field butt joints including lay-up sequence, width of each reinforcement layer, and total number of layers.

1.04 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01600 - Product Requirements with additional requirements in Section 15500 - Common Work Results for HVAC.

2.02 MANUFACTURERS

A. Fiberglass reinforced plastic ductwork:
   1. One of the following or equal:
      a. Daniel Mechanical.
      b. Engineered Composite Systems.
      c. Perry Fiberglass Products, Inc.
      d. NOV Fiber Glass Systems.

2.03 DESIGN AND PERFORMANCE CRITERIA

A. Ducting for HVAC, Chlorine Scrubber systems and Ventilation systems:
   1. Minimum internal pressure: 20.0 inches water gauge.
   2. Minimum internal vacuum: 20.0 inches water gauge.

B. Support spacing: As needed to comply with wall thicknesses calculations but not greater than the following:
   1. Contact-molded ductwork: Not greater than 5 foot centers.
   2. Filament-wound ducts: In accordance with SMACNA standards below:

Duct Inside Diameter (Inches)	Maximum Span (Feet)
3 to 19	10
20 to 29	15
30 to 35	20

C. Minimum flooding: Design ductwork for water accumulation as follows:
   1. Rectangular ductwork: 1-inch deep across bottom of duct.
   2. Round ductwork: 2 inches deep across bottom of duct.

D. Physical and mechanical properties: Duct shall meet the following standards for physical and mechanical properties:

Pipe Property	Standard	Design Properties	
		Hoop (PSI)	Axial (PSI)
Ultimate Flexural Stress Flexural Modulus	ASTM D2412	50,000 3.05×10^6	18,000 1.0×10^6
Ultimate Tensile Stress Tensile Modulus	ASTM D2105	52,000 1.5×10^6	7,485 1.56×10^6
Ultimate Shear Strength		Approximate Typical Values (PSI)	
Interlaminar Cross	ASTM D2344	2130-2730 15,000	
Density	ASTM D792	0.065-0.072 lb./In^3	

E. Design tensile stress:
   1. Calculations for design of wall thickness assume a laminate ultimate tensile stress of 9,000 pounds per square inch maximum.
   2. Decrease ultimate tensile stress as appropriate to the laminate design.
      a. Round ducting: The maximum allowable design tensile stress shall be the ultimate tensile stress divided by 5.
      b. Rectangular ducting: The maximum allowable design tensile stress shall be the ultimate tensile stress divided by 10.

F. Manufacturer shall provide design calculations for FRP ductwork design and construction. Calculations shall be signed and sealed by licensed engineer registered in the state of the project location

2.04 DUCTWORK MATERIALS

A. As specified in applicable portions of Section 06608 - Fiberglass Reinforced Plastic.

B. Minimum corrosion liner:
   1. Interior surfacing "C" or Nexus veil as specified for the service environment.
   2. Exterior surfacing: “C” or “A” veil.
   3. Remainder 1-1/2 ounce per square foot mat to total minimum thickness of 0.096 inches on surface exposed to the service environment.
   4. Duct shall be resistant to the following in accordance with ASTM C582:

Sulfuric Acid	75 percent	At 100 degrees Fahrenheit
Nitric Acid	20 percent	At 100 degrees Fahrenheit
Sodium Hydroxide	50 percent	At 100 degrees Fahrenheit
Hydrofluoric Acid	20 percent	At 100 degrees Fahrenheit

C. Ultraviolet stabilizer:
   1. All exposed external surfaces of all FRP ductwork installed outdoors shall be provided with protection against ultraviolet degradation and weather erosion.
   2. The duct shall carry the flame spread rating of 25 or less in accordance with ASTM E84 and a smoke contribution rating in excess of 1,000 in accordance with NPFA 91.
   3. External duct protection shall be provided by an ultraviolet stabilizer added to the final coat or resin that also incorporates paraffin wax curing elements and color pigment.
   4. An alternative system to polyurethane paint with color pigments may be used if approved by the Owners Designated Representative.

D. Resin:
   1. The external surface and structural layers of all FRP ductwork shall carry a flame spread rating of 25 or less in accordance with ASTM E84 and a smoke contribution of 50 or less in accordance with NFPA 91.
   2. Premium vinyl ester as follows unless otherwise recommended by the resin manufacturer for the service environment:
      a. Resin for structural layers: Resin with sufficient antimony trioxide or pentoxide for Class I fire rating.
      b. Manufacturers: One of the following or equal:
         1) Ashland, Hetron 992FR.
         2) Reichhold Dion, VER 9300FR.

E. Color: Add pigment to the exterior surface resin coat such that the color of the duct will be similar to paint used for equipment, except that ducting for air conditioning systems which are concealed above suspended ceilings need not be pigmented. Color selected by Owner.

F. Provide fasteners, field joints, expansion joints, and supports required for complete installation of a duct system.

G. Flanges:
1. All flanges shall be hand laid up to the thickness specified in accordance with ASTM D3982.
2. FRP flanges shall be made of the same materials as the FRP ductwork.
3. Flange bolt hold pattern as well as flange dimensions, shall be in accordance with NIST PS 15 Tables 2 and 5 for duct and pipe, respectively, except for thickness. Thickness of flange shall be a minimum of 1/2 inch.
4. Flanges shall be manufactured using the hand lay-up technique and shall be integral to the duct in accordance with ASME RTP-1. Filament-wound and/or random chopped methods of constructing flanges will not be acceptable.

Pipe Diameter, Inches	Minimum Flange Thickness, Inches
Less Than 12	1/2
12-24	1/2
25-41	5/8
42-60	3/4

2.05 DUCTWORK FABRICATION

A. Hand lay-up or filament wound construction as specified in Section 06608 - Fiberglass Reinforced Plastic.
1. Provide wall thickness necessary to comply with design criteria but not less than the following minimum thicknesses.
2. Structural wall thicknesses shall not include the thickness of the interior corrosion barrier, inner surface, and interior layer:

Duct Size	Round Ducting (wall thickness, inches)	Rectangular Ducting (wall thickness, inches)	Buried Ducting (wall thickness, inches)
For 18 inch & smaller ducts	0.1875	0.25	0.34
20 to 36 inch ducts	0.25	0.375	0.42
42 to 54 inch ducts	0.375	0.500	0.60
60 to 72 inch ducts	0.438	0.625	0.625

B. Fittings:
1. Type: Hand lay-up contact molded.
2. Resin: Identical to and with same strength as resin used for FRP ductwork.
3. Wall thickness: At least equal to the thickness of the thickest adjacent ducting.
4. Internal diameter: Equal to the adjacent duct.

5. Tolerance:
    a. Angles for all fittings shall be within 1 degree for up to 30-inch diameter duct.
    b. Angles for all fittings shall be within 1/2 degree for over 30-inch diameter and above duct.
6. Round standard elbows:
    a. Standard elbow centerline radius shall be equal to 1-1/2 times the diameter unless otherwise **indicated on the Drawings**.
    b. Standard elbows up to 24-inch diameter shall be smooth radius elbows. Standard elbows of 26-inch diameter and greater may be mitered sections as follows:
        1) 0 to 44 degree elbows shall contain 1 mitered joint and 2 sections.
        2) 45 to 80 degree elbows shall contain a minimum of 2 mitered joints and 3 sections.
        3) Elbows greater than 80 degrees shall contain a minimum of 4 mitered joints and 5 sections.
    c. Provide turning vanes in all round mitered elbows. Round elbow turning vanes shall be of FRP construction, solid or double wall construction with an airfoil shaped profile.
7. Rectangular elbows:
    a. Fittings shall be factory manufactured to meet the specified design criteria and in accordance with approved submittals. Factory install reinforcing ribs as required to meet the specified deflection requirements and to provide a system free from pulsing, warpage, sagging, and undue vibration.
    b. Provide turning vanes in all rectangular elbows. Rectangular elbow turning vanes shall be of FRP construction, solid or double wall construction with an airfoil shaped profile.

C. Joints:
1. Flanged:
    a. Flanged in accordance with ASTM D3982 and bolt hold patterns in accordance with NIST PS 15, Table 2.
    b. Flanged joints shall be provided at the following locations:
        1) At each damper and each item of equipment to facilitate disassembly.
        2) At each change in material.
        3) Where **indicated on the Drawings**.
    c. Gaskets for flanged joints: 1/8-inch neoprene over full flange face.
    d. Bolt nuts and washers: Type 316 stainless steel.
2. Butt and strap welded:
    a. Field butt and strap welded joints shall be provided at the following locations:
        1) 12 inches from any increasing or decreasing cross-section of pipe.
        2) Where the pipe to be joined has the same diameter.
    b. Thickness of butt and strap joint overlays: At least equal to the thickness of the thickest adjacent duct.
    c. Field weld kits:
        1) All necessary fiberglass and reinforcing material shall be supplied pre-cut and individually packaged for each joint.
        2) Bulk Glass rolls will not be acceptable.

2.06 FLEXIBLE CONNECTIONS

A. Flexible connection shall be provided as **indicated on the Drawings**. When flexible connections are not shown, they shall be provided at all duct to rotating equipment connections.

B. FL-3, Duct to Equipment Heavy Duty Flexible Connection:
   1. Materials: EPDM rubber vulcanized with minimum of 1 ply of reinforcing fabric; 3/16 inch thick.
   2. Unit shall have minimum movement of:
      a. Axial compression: 2.25 inches.
      b. Axial extension: 1.25 inches.
      c. Lateral offset: 1.25 inches.
   3. Provide 3/8-inch thick by 2-inch wide pre-drilled retaining rings/back-up bars to clamp the expansion joints into the ducting system.
   4. The expansion joint shall be of fully molded construction. Splices will not be allowed in the body of the expansion joint.
   5. Manufacturers: One of the following or equal:
      a. Proco Series 500, Style 530 Fabric Fan Connector.
      b. Holz Rubber Style 952 Arch Design Expansion Joint.

2.07 EXPANSION JOINTS

A. Expansion joints shall be provided as **indicated on the Drawings**. When expansion joints are not shown, they shall be provided in above grade duct at maximum spacing of 40 foot centers.

B. Construction:
   1. Body: EPDM.
   2. Reinforcing: Multiple layers (2 minimum) of impregnated polyester or Kevlar tire cord fabric.
   3. Flange rings: Type 316 stainless steel or minimum 3/4 inch thick FRP.
   4. Hardware/Fasteners: Type 316 stainless steel.
   5. Minimum pressure rating: 1 pounds per square inch.
   6. Minimum vacuum rating: 1 pounds per square inch.
   7. Minimum operating temperature: 175 degree Fahrenheit.
   8. Connections: Flanged in accordance with NIST PS 15, Table 2.
   9. Seamless construction built as on continuous piece. Wrapped, seamed, or spliced type expansion joints are not acceptable.
   10. Provide Type 316 stainless steel control rods.

C. Minimum movement:
   1. Axial compression: 2.25 inches.
   2. Axial extension: 1.25 inches.
   3. Lateral offset: 1 inch.

D. Manufacturers: One of the following or equal:
   1. Daniel Co., DanFLEX Model 101.

2. Mercer Rubber Co., Model ME for Rectangular, Model MI-9 for Round.

2.08 DUCT SUPPORTS

A. Provide duct supports as **indicated on the Drawings**.

B. Protect the duct from clamping force of strap hangers with a 1/8-inch thick layer of neoprene pad.

C. When anchors are required, they shall be externally bonded to the duct. Drive screws or other penetrations of the duct linter are not permitted.

D. When duct supports are not **indicated on the Drawings** provide supports and seismic bracing in accordance with the SMACNA Design Manual.

2.09 SHOP INSPECTION

A. Each load of FRP duct or pipe shall be shop inspected during fabrication and prior to shipment.
   1. Inspection shall be conducted by qualified third-party inspectors that have extensive experience in the design, manufacture, testing, and installation of all FRP duct and pipe.
   2. The cost for third-party inspection shall be borne by the manufacturer.
   3. The name, resume, and qualifications of the third-party inspector shall be submitted to the Engineer for approval. Acceptable inspection engineers shall be one of the following or equal:
      a. Fiberglass Structural Engineers, Inc.
      b. FEMech Engineering.

2.10 SHIPPING, SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. As specified in Section 01600 - Product Requirements with additional requirements in Section 15500 - Common Work Results for HVAC.

PART 3 EXECUTION

3.01 GENERAL

A. As specified in Section 01600 - Product Requirements with additional requirements in Section 15500 - Common Work Results for HVAC.

3.02 INSTALLATION

A. All ductwork shall be fabricated and erected where **indicated on the Drawings** or as specified in this Section. Ductwork shall be rigidly supported and secured in an approved manner.

B. Install ductwork parallel to walls and/or roof and vertically plumb.

C. Bracing and vibration isolators shall be installed, where necessary, to eliminate vibration, rattle and noise.
   1. Hangers shall be installed plumb and securely suspended from supplementary steel or inserts in concrete slabs.
   2. Lower ends of hanger rods shall be sufficiently threaded to allow for adequate vertical adjustment.
   3. Building siding and metal decking shall not be used to hang ductwork.

D. Contractor shall not install any equipment or materials until the Owners Designated Representative has approved all submittals. If any equipment or materials are installed prior to approval of the submittals, it shall be at the Contractor's risk.

E. Wherever ducts are divided, the cross-sectional area shall be maintained. All such changes must be approved and installed as directed by the Owners Designated Representative or as approved on shop or erection drawings.

F. Do not remove or alter factory installed duct reinforcing ribs except as required to accommodate duct alterations due to unexpected field conditions.
   1. Notify the Owners Designated Representative prior to starting any field modifications involving ductwork structural reinforcing members.
   2. Submit additional design calculations to demonstrate structural design integrity of ductwork and fittings requiring reinforcing modifications in the field.

G. No ductwork or components shall be shipped prior to complete resin cure.

H. Cover ductwork openings with tape, plastic, or sheet metal to reduce the amount of dust or debris which may collect in the system at each of the following times:
   1. At the time of rough installation.
   2. During storage on the construction site.
   3. Until final start-up of the heating and cooling equipment.

I. Before installation remove dust and debris from ducts.

J. Install products in accordance with shop drawings and manufacturer's instructions. Drawings indicate general routing only and shall be modified as necessary.

END OF SECTION

SECTION 23 31 10
DUCTWORK ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-23 Basic HVAC Materials and Methods sections apply to work of this section.

1.2 SUMMARY:

A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

B. Types of ductwork accessories required for project include the following:

1. Duct hardware.
2. Flexible connections.

C. Refer to 23 05 93 for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division-1.

1.5 REFERENCES:

A. Codes and Standards:

1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".

4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Protection: Protect shop-fabricated and factory-fabricated accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store accessories inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCT HARDWARE:

A. General: Provide duct hardware, typically of one manufacturer, for all items on project, for the following:

1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, cover, for instrument tests. Ventlok No. 699 closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.

2.2 FLEXIBLE CONNECTIONS:

A. Extent of Work: Provide flexible connections between ductwork and equipment, such as at fan inlets and discharges, and at other places indicated on the drawings or called for by note or specification.

B. Non-Corrosive Environment or Airstream: For system pressures up to 5” w.c, provide material of heavy waterproof woven glass fabric double coated with neoprene or Hypalon equivalent to “Ventglas” for interior locations and “Ventlon” for exterior locations, fabric not less than 3-1/4" wide clamped between strips of 24 gauge stainless steel or 20 gauge aluminum alloy. Material by Ventfabrics, Inc., Chicago, Ill.

C. Corrosive Environments or Airstream: Provide material of heavy waterproof woven fiberglass fabric coated with Teflon equivalent to “Ventel” by Ventfabrics, Inc., Chicago, Ill.

By nature, the material is slippery and requires rigid clamping in the field installation. Install with the coated side to the corrosive air stream. Clamp the material into a stainless steel edging or hinge with a folded fabric edge. Be careful in securing the clamped fabric to the fan or duct as to not penetrate or disturb any protective coatings or surfaces.

PART 3 – EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES:

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

C. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL:

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

3.4 ADJUSTING AND CLEANING:

A. Adjusting: Adjust ductwork accessories for proper settings

Label access doors in accordance with Division-23 section "Mechanical Identification".

Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 37 00
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY:

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

B. Types of outlets and inlets required for project include the following:

1. Louvers.

C. Refer to other Division-23 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

D. Refer to other Division-23 sections for balancing of air outlets and inlets; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects with metal ductwork systems work similar to that required for project.

The Installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Installer.

All workmen on the project shall carry state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.

3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Samples: 3 samples of each type of finish furnished.

C. Shop Drawings: Submit manufacturer's assembly type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division-1.

1.5 REFERENCES:

A. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

3. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".

4. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.

5. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air outlets and inlets wrapped in factory fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DRAINABLE BLADE LOUVERS:

A. Extent of Work: At air openings in the outside wall where indicated on drawings, install AMCA rated drainable stationary extruded aluminum 6" deep weather louvers with bird screens.

B. Material: Blades shall be 6 inches deep with integral downspouts to drain the water from the louver blades. Stationary louvers shall pass 1000 fpm free area velocity with less than 0.15" static pressure drop and shall carry less than .03 ounces of water per square foot when tested in accordance with AMCA Standard 500. Install screens on interior face and louver.

C. Finish system shall be 2.0-mil, PVF2 Kynar 500, formulated by a licensed formulator to contain 70 percent PVF resin and applied by a licensed applicator.

1. Epoxy prime coat shall be applied to exposed sides to a dry film thickness of approximately 0.2-mil. One coat of PVF color coating shall be applied to exposed sides to provide a dry film thickness of not less than 0.8-mil, for a total of 1.0-mil total coating.

2. The surface condition of this finish coat shall be 100 percent free of holidays, drip marks, scratches, roll marks, or abrasions that are visible from a distance of 5-feet in good light when in installed position. Surfaces shall be free of checking, crazing, peeling, or loss of adhesion.

3. Finish shall meet or exceed AAMA 2605.

4. Color shall be selected and approved by owner from manufacturer's standard color selections.

    a. Color shall be uniform with no variation in shade, and louvers or accessories of different color batches will not be acceptable.

    b. The Owner reserves the option of changing this tentative color selection during the submittal process at no additional cost to Owner.

D. Manufacturer: Louvers shall be equal to American Warming and Ventilating, Louvers and Dampers, Krueger, Ruskin, Cesco, NCA Manufacturing or U.S. Louvers.

E. Contractor is required to coordinate louver size, flange type, and construction with structural and architectural openings to assure fit and appearance. Except for very large units, louvers shall be one piece.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

END OF SECTION

SECTION 23 61 00
PACKAGED HVAC EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL MECHANICAL REQUIREMENTS:

A. All pertinent sections of Section 23 05 00 - General HVAC Requirements are a part of the work described in this section.

1.2 SUMMARY:

A. This section specifies:

1. Wall Mounted Air Conditioning Units

1.3 STANDARDS:

A. Uniform Building Code/International Mechanical Code

B. Local Codes and Ordinances

C. State Pressure Vessel Regulations

D. EPA Requirements.

E. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

F. ANSI/ASHRAE 90A - Energy Conservation in new Building Design.

G. ARI 370 - Sound Rating of Large Refrigeration and Air-conditioning Equipment.

H. ARI 360 - Unitary Air-Conditioning Equipment.

1.4 SHOP DRAWINGS/SUBMITTALS:

A. Submit a list of all materials to be used indicating brand or source, type and service.

B. Submit shop drawings for all equipment including shop drawing showing proposed sizes, capacities, accessories, manufacturer and model numbers, wiring diagrams, etc.

1.5 CONTRACTOR QUALIFICATION:

A. The Piping Contractor for this work shall be licensed as a firm in the Contractor state of origin and in the state where the work is performed.

B. The Subcontractor shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Subcontractor.

C. All workmen employed in the project shall carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.

1.6 SCOPE OF THE WORK:

A. Furnish and install all refrigeration equipment and related work to effect a complete installation.

1. Provide and install Refrigeration Equipment as indicated on the drawings.

2. Other work indicated on the drawings.

1.7 INSTRUCTION OF OWNER'S PERSONNEL:

A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.

B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.

1.8 WARRANTIES: See Section 23 05 00.

PART 2 – MATERIALS AND METHODS

2.1 WALL MOUNTED AIR CONDITIONING UNIT (WAC-1)

A. GENERAL: Provide self-contained, factory-assembled and tested, wall mounted, horizontal discharge supply and return, single-piece, 3 stage cooling unit with electric heat and full outside air economizer suitable for outdoor use. Contained within the unit enclosure shall be all factory wiring, piping, controls, refrigerant charge (R-410A), and special features required prior to field start-up.

B. PERFORMANCE:

1. See Equipment Schedule.

C. UNIT CABINET:

1. Unit cabinet shall be constructed of minimum 16 gauge zinc-coated galvanized steel, bonderize and coated with baked enamel or satin beige polyester finish on all externally exposed surfaces and interior panels which shall allow it to withstand a minimum of 1000 hours of salt spray exposure per ASTM B117-03.

2. The fan cabinet interior shall be insulated with a minimum 1/2-in thick, closed cell foam insulation with acrylic or neoprene coating on the air side.

3. The evaporator cooling section shall be insulated with a minimum 1/2-in thick, 2 lb. closed cell foam insulation with acrylic or neoprene coating on the air side.

4. Cabinet panels shall be easily removable for servicing.

5. Cabinet shall include a sloped top and built-in mounting flanges. Slots or holes shall be provided in the unit to facilitate transporting unit to location of installation.

6. Unit shall have a factory-installed, sloped stainless steel condensate drain pan, providing a minimum 3/4 in. connection with both vertical and horizontal drains and shall comply with ASHRAE 62.

7. Unit shall have factory-installed filter access panel to provide filter access with tool-less removal.

8. Unit shall have standard single point power connection point.

D. FANS:

1. Indoor blower (evaporator fans) shall be of the direct-driven, EC Motor Plenum fan. Impeller blades shall be made from aluminum with steel frame construction and shall be dynamically balanced.

2. Condenser fan shall be of the direct-driven propeller type and shall discharge air horizontally.

E. COMPRESSOR:

1. The compressors shall be scroll type with one 2-stage compressor and one single stage compressor.

F. COILS:

1. Evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed. Coils shall be provided with a corrosive resistant coating.

2. Tube sheet openings shall be belled to prevent tube wear.

3. Evaporator coil shall be of the full-face active design.

G. REFRIGERANT COMPONENTS: Each of the two refrigerant circuits shall include:

1. Refrigerant strainer.

2. Sight Glass.

3. Expansion Valve.

4. Service gauge connections on suction, discharge, and liquid lines.

5. Suction and liquid access valves.

6. Filter drier.

H. FILTER SECTION:

1. Filter section shall consist of factory-installed low-velocity, throwaway, 2-in. thick, pleated filters of commercially available sizes (Farr 30-30 or equal).

2. Filter face velocity shall not exceed 300 fpm at nominal airflows.

3. Filters shall be accessible through an access panel with 'no-tool" removal.

4. Provide dirty filter indicator switch.

I. CONTROLS AND SAFETIES:

1. Unit Controls: Furnish unit with factory wired on-board PLC and a remote mounted PGDx touchscreen temperature and humidity controller. Furnish unit with the optional Free Cooling Economizer and all associated controls. Furnish unit with optional factory wired electric heat package and all associated controls.

2. Safeties:

a. Unit shall incorporate a solid-state compressor protector which provides anti-cycle reset capability at the space temperature controller, should any of the following standard safety devices trip and shut off compressor.

1) Compressor over temperature, over current.

2) Loss-of-charge/low-pressure switch with automatic reset.

3) Freeze-protection thermostat, evaporator coil.

4) High-pressure switch. The lockout protection shall be easily disconnected at the control board, if necessary.

J. ELECTRICAL REQUIREMENTS:

1. All unit power wiring shall enter unit cabinet at a single factory-predrilled location. The air conditioner shall have a factory installed disconnect.

K. MOTORS:

1. Compressor motors shall be cooled by refrigerant passing through motor windings and shall have line break thermal and current overload protection.

2. Evaporative fan motor shall be electrically commutated with sealed, permanently lubricated, ball-bearings, temperature protection, soft start and an integrated PID controller. Maximum 1100 RPM.

3. Condenser-fan motor shall be totally enclosed, electrically commutated with sealed, permanently lubricated, ball-bearings, temperature protection, soft start and an integrated PID controller. Maximum 1100 RPM.

L. SPECIAL FEATURES:

1. Service: Air conditioning unit shall be equipped with hinged access panel for the filter, compressors(s), evaporator fan, and control box areas. Filter hinged access panels permit tool-less entry by removing and discarding screws. Each external hinged access panel shall be permanently attached to the air conditioning unit and equipped with a retainer for service convenience. The electrical control box, including the low voltage compartment, shall be accessible from the front of the air conditioner.

2. Fused disconnect switch: Provide fused disconnect switch factory-installed, internally-mounted. NEC and UL approved fused switch shall provide unit power shutoff. The control access door shall be interlocked with the fused disconnect. The disconnect switch must be in the OFF position to open the control box access door. Shall be accessible from outside the unit and shall provide power off lockout capability.

3. Furnish unit with factory supply and return grilles with brushed aluminum finish.

M. ACCEPTABLE MANUFACTURERS:

1. Subject to compliance with requirements, provide air conditioning unit from:

a. Bard MEGA-TEC
b. Engineer approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION OF WALL MOUNTED AIR CONDITIONING UNITS:

A. General: Install unit where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

B. Coordination: Coordinate with other work, including wall construction, wall openings and electrical as necessary to interface installation of units with other work.

C. Access: Provide access space around units for service as indicated, but in no case less than that recommended by the manufacturer.

D. Support: Securely anchor units to the wall.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

F. Duct Connections: Refer to Division-23 Sections Air Distribution sections. Provide ductwork sleeves connecting to unit supply and return air openings as indicated on the drawings in preparation for insertion of unit supply air diffuser and return air grille.

3.2 DUCTWORK - GENERAL:

A. Standards: All duct fabrications shall comply with standards and techniques detailed by SMACNA "Duct Construction Manuals" for the appropriate pressure class, and with the ASHRAE Handbook, HVAC Systems and Equipment, 2016 edition, Chapter 19, Duct Construction.

B. Sheet Metal: Fabricate ductwork sleeves from galvanized steel, in gauges corresponding to the SMACNA recommendations.

C. Provide galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 120 zinc coating in accordance with ASTM A 525.

D. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.

E. Ducts at Structural and Architectural Penetrations: Where ducts are shown connecting to masonry openings, provide a continuous 2" x 2-1/8" stainless steel angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Close openings between duct and structure.

F. Grounding: Provide positive equipment ground for wall mounted air conditioning unit components.

END OF SECTION

SECTION 23 76 00
TERMINAL ELECTRIC HEAT TRANSFER UNITS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-23 Motors Drives and Electrical Requirements for Mechanical Systems, General Mechanical Requirements, and General Pipes and Fittings sections apply to work of this section.

1.2 SUMMARY:

A. Types of terminal units required for project include the following:

1. Unit heaters, electric

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATER (UH-1):

A. General: Provide electric unit heaters in location as indicated, and of capacities, and style and having accessories as scheduled.

B. Unit shall be complete factory assembled, wired and tested. Ready for installation and connection to electrical power source and control package.

C. Electric unit heaters shall be provided with totally enclosed, corrosion-resistant, UL listed motor with permanently lubricated ball bearings, NEMA 4X enclosure, epoxy coated, aluminum fan blade. Single point power connection. Furnish with heavy duty hanging bracket.

D. Provide unit heaters with an adjustable louvered air outlet grille, heavy gauge plate rear grille for protection against accidental contact with the fan blade.

E. Provide with automatic temperature controls built into unit with field mounted thermostat, 40 degree to 100 degree temperature range, three position switch wired to control for on, standby and fan only settings, indicating light for when heating elements are energized. 24 volt transformer and control circuit.

F. Manufacturer: Subject to compliance with requirements, provide electric unit heaters of one of the following:

1. Reznor
2. Approved equal

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 INSTALLATION OF TERMINAL HEAT TRANSFER UNITS:

A. General: Install heaters as indicated, and in accordance with manufacturer's installation instructions.

B. Locate heaters where indicated.

C. Provide and install hangers and supports for heater.

3.3 ELECTRICAL WIRING:

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted.

3.4 ADJUSTING AND CLEANING:

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 23 82 00
POWER VENTILATORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-23 General Mechanical Requirements sections apply to work of this section.

C. See Section 23 06 07 Motors, Drives and Electrical Requirements for Mechanical Work.

1.2 SUMMARY:

A. Extent of power and gravity ventilator work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of power and gravity ventilators specified in this section include the following:

1. Inline Exhaust Fans.

C. Refer to Division 23, Section 23 05 93 "System Commissioning, Testing and Balancing" for balancing of power and gravity ventilators; not work of this section.

D. Refer to Division-23 and 40 temperature control and instrumentation systems sections for control work required in conjunction with power and gravity ventilators; not work of this section.

E. Refer to Division-26 sections for the following work; not work of this section.

1. Power supply wiring from power source to power connection on ventilators. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory installed, by manufacturer.

2. Interlock wiring between ventilators; and between ventilators and field installed control devices as shown in Division-26.

Interlock wiring specified as factory installed is work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of power and gravity ventilators, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical data for power and gravity ventilators, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.

B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to power ventilators. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.

D. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division-23.

1.5 REFERENCES:

A. Codes and Standards:

1. AMCA Compliance: Provide power ventilators which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Rating Seal.

2. UL Compliance: Provide power ventilators which are listed by UL and have UL label affixed.

3. NEMA Compliance: Provide motors and electrical accessories complying with NEMA standards.

PART 2 – PRODUCTS

2.1 INLINE CENTRIFUGAL EXHAUST FAN (EF-1):

A. General: Fan shall be duct mounted, direct driven centrifugal square inline with air flow capacity as scheduled, centrifugal exhaust ventilator.

B. Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance. Fan shall be provided with a phenolic coating for all components exposed to the airstream.

C. The fans shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

D. Fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM and static pressure. Unit shall be shipped in ISTA certified transit tested packaging.

E. The motor, bearings and drive shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust air stream. Lifting lugs shall be provided to help prevent damage from improper lifting.

F. The fan wheels shall be non-sparking centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic inlet cone. Wheel shall be statically and dynamically balanced in accordance with AMCA Standard 204-96.

G. The Motor shall be an electronically commutated motor rated for continuous duty and furnished either with internally mounted potentiometer speed controller or with leads for connection to 0-10 VDC external controller.

H. Accessories:

1. Provide fan with backdraft damper.

I. Manufacturer: Subject to compliance with requirements, provide inline centrifugal exhaust fans of one of the following:

1. Acme
2. Cook
3. Pace
4. Greenheck
5. Penn
6. Twin-City
7. FanTech

PART 3 - GENERAL

3.1 INSPECTION:

A. General: Examine areas and conditions under which power ventilators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF POWER VENTILATORS AND FANS:

A. General: Except as otherwise indicated or specified, install power ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that products serve the intended function.

B. Coordinate ventilator work with work of roofs, walls and ceilings, as necessary for proper interfacing.

C. Ductwork: Refer to Divisions-23 sections 23 31 00 "Ductwork" and 23 31 10 “Ductwork Accessories.” Connect ducts to ventilators in accordance with manufacturer's installation instructions.

D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted.

E. Remove shipping bolts and temporary supports within ventilators. Adjust dampers for free operation.

3.3 FIELD QUALITY CONTROL:

A. Testing: After installation ventilators have been completed, test each ventilator to demonstrate proper operation of unit at performance requirements specified. When possible, field correct malfunctioning units, and then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.4 ADJUSTING AND CLEANING:

A. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 23 90 00
AIR FILTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-23, Section 23 05 00 General HVAC Requirements sections apply to work of this section.

1.2 SUMMARY:

A. Extent of air cleaning work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of air cleaning equipment specified in this section include the following:

1. Air Filters.

a. Extended surface self-supporting.

C. Refer to Division-23 duct accessories section for duct access door work required in conjunction with air filters; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air cleaning equipment of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data including, dimensions, weights, required clearances and access, flow capacity including initial and final pressure drop at rated air flow, efficiency and test method, fire classification, and installation instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for filter rack assemblies indicating dimensions, materials, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and spare parts lists for each type of filter and rack required. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division-23.

1.5 REFERENCES:

A. Codes and Standards:

1. UL Compliance: Comply with UL Standards pertaining to safety performance of air filter units.

2. ASHRAE Compliance: Comply with provisions of ASHRAE Standard 52 for method of testing, and for recording and calculating air flow rates.

3. ARI Compliance: Comply with provisions of ARI Standard 850 pertaining to test and performance of air filter units.

PART 2 - PRODUCTS

2.1 AIR FILTERS:

A. Manufacturers: Subject to compliance with requirements, replaceable filter media and holding frames shall be a product of one of the following:

1. American Air Filter
2. Continental
3. Farr

B. Holding Frames: Suitable for filters specified. Frame and brace into solid assemblies.

1. May be side access, factory fabricated type.

C. Replaceable pleated media type filters.

1. Pleated, medium efficiency in a cardboard holding frame, 2" or 4" thick as scheduled, 0.32" s.p. maximum initial pressure drop at 500 feet/minute, to change out at 0.50". U.L. Class 2, 25-30% efficiency, 90-95% arrestance per ASHRAE Standard 52-76. Typical selection for 300 feet/min, or less.

2. Equivalent to Farr 30/30.

D. Startup Set:

1. Install a set of filters immediately upon fabrication of any filter bank. Install scheduled set of filters at completion of construction at the time of testing and balancing.

E. Replacement Set:

1. Furnish a second set of filters for each unit to be turned over to Owner as initial replacement stock.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air filters and filter housings will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION:

A. General: Comply with installation requirements as specified elsewhere in these specifications pertaining to air filters housing/casings, and associated supporting devices.

B. Install air filters and holding devices of types indicated, and where shown; in accordance with air filter manufacturer's written instructions and with recognized industry practices; to ensure that filters comply with requirements and serve intended purposes.

C. Locate each filter unit accurately in position indicated, in relation to other work. Position unit with sufficient clearance for normal service and maintenance. Anchor filter holding frames securely to substrate.

D. Coordinate with other work including ductwork and air handling unit work, as necessary to interface installation of filters properly with other work.

E. Install filters in proper position to prevent passage of unfiltered air.

F. Install air filter gage pressure tips upstream and downstream of filters to indicate air pressure drop through air filter. Mount filter gages on outside of filter housing or filter plenum, in accessible position. Adjust and level inclined gages if any, for proper readings.

3.3 FIELD QUALITY CONTROL:

A. Operate installed air filters to demonstrate compliance with requirements. Test for air leakage of unfiltered air while system is operating. Correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.

END OF SECTION

SECTION 26 05 00
ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 GENERAL

A. This Section consists of the Electrical General Requirements and related items necessary to provide complete and operational electrical system(s) indicated within the Contract Documents.

1.2 APPLICABLE SECTIONS AND REQUIREMENTS

A. The General Conditions, Supplementary Conditions, Special Conditions, Alternates and Addenda, applicable drawings, and the technical specifications herein shall apply to all work specified herein.
B. The CONTRACTOR shall comply with the specifications and accompanying drawings which describe and provide for the furnishing, delivering, installing, testing, and placing in satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete electrical system for power distribution, control, lighting, and auxiliary systems.
C. State Licensed Contractor - All contractors must have a current state contracting license. The CONTRACTOR shall be licensed as such in the CONTRACTOR state of origin and in the state where the work is performed.
D. The electrical contractor shall have a licensed Master Electrician assigned to direct the electrical work and to coordinate work with the General Contractor and other trades. Furthermore, a licensed journeyman electrician shall be assigned to supervise the actual performance of all electrical work specified herein.
E. The licensed journeyman assigned to supervise the performance of all electrical work, shall be required to be on the job site at all times, while electrical work is being performed.

1.3 CONTRACT DOCUMENTS

A. Contract documents consist of drawings, specifications, and other documents issued by the ENGINEER. Each is complementary and requirements shown, written or reasonably inferred there from on one is considered as written, shown or implied in all. In the event work is called for in more than one place and is of conflicting requirements, the right shall be reserved to require the installation of the larger or the more expensive.
B. The drawings are diagrammatic, intended to indicate the general scope and locations of the work to be installed and are not to be considered as complete in every detail, but shall be followed as closely as actual construction and work of other contractors will permit.
C. Data given herein and on drawings are as exact as could be secured, but their extreme accuracy is not guaranteed. Drawings and specifications are for the assistance and guidance of the

CONTRACTOR; but exact locations, distances, and levels will be governed by actual conditions, and the CONTRACTOR is to verify all dimensions given on the drawings, and to report any discrepancy or inconsistency to the ENGINEER before commencing with the work.

D. The CONTRACTOR shall install all work indicated and/or specified herein, complete to perform the function intended without additional cost. Raceway and conductors to panels from devices referred to as "home runs" are indicated by pointing in the general direction of panels. Construction shall continue such circuits to the panels as though the routes were completely indicated. Home runs shall be installed from devices to panels as indicated.

E. Deviations from the drawings required to make work of this contract conform to actual conditions as constructed, or as to work of other contractors, shall be made by the CONTRACTOR at his expense. The ENGINEER reserves the right to make minor changes in the location of equipment and devices without additional charges.

F. The CONTRACTOR shall familiarize himself with the architectural, structural, and civil/mechanical drawings and shall study drawings and details so that equipment will be properly located and readily accessible. If any conflicts occur necessitating departures from the contract drawings, details of departures and reasons therefore shall be submitted for prior approval.

G. In any case and at any time, a change in material or location is made necessary by CONTRACTOR's failure to take into account obstacles or the installation of other trades shown, whether on electrical drawings or other drawings, in existence at the time bids were received, such changes shall be made without charge to OWNER.

H. Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Where drawings are required for these purposes or have to be made from field measurements, they shall be prepared by the CONTRACTOR, Shop Drawings of various contractors shall be coordinated to take into account all obstacles that will interfere with the installation.

I. Every attempt has been made to indicate the installation and wiring requirements for all equipment to be installed. However, it shall be the CONTRACTOR’s responsibility to coordinate with equipment shop drawings and make adjustments necessary including; power and control wiring sizes and counts, breaker sizes, rough-in locations, etc. for actual equipment provided. The contractor shall provide in his bid the conductors and conduits required for the equipment to be installed. The contractor shall reference the mechanical drawings, the P&ID drawings, the control diagrams, the control drawings, the power drawings, the one line diagrams and all schedules. The contractor shall at his expense provide

J. The conduit and conductors for the equipment installation for a complete and functional system.

K. Every attempt has been made in the drawings to indicate the general installation requirements for the power and control connections for the equipment indicated. However, equipment requirements vary from manufacturer to manufacturer and from date to date for equipment. The responsibility to coordinate the exact requirements of all equipment and install the required systems for these systems shall belong to the contractor, at his expense. No additional

costs to the owner shall be incurred for the contractor's failure to coordinate these equipment requirements at the time of bid.

L. Electrical drawings are diagrammatic in nature and are not intended to show shop drawing style connections, equipment installation coordination or exact conduit and conductor sizes or counts. The contractor shall at his expense coordinate and provide necessary electrical and control components for a complete and functional system. If any conduit, equipment schedule, sizing, capacities, counts, lengths are unclear at the time of bidding or if conflicts exist on the drawings or in the specifications, the owner reserves the right for the installation of the more expensive or the more involved at no additional cost to the owner.

1.4 INFORMATION FOR ENGINEER

A. Submit the required information in accordance with the General Conditions, Section 00 70 00, and the following requirements.

1. The CONTRACTOR shall check all shop drawings for conformance with Contract Documents before submitting. The CONTRACTOR shall note on shop drawings any changes from items specified listing reasons and giving source of change such as "Approved Equal", "Addendum", or "Change Order". The CONTRACTOR shall be responsible for conformance with drawings and specifications; for dimensions to be confirmed and correlated at the job site: for information that pertains solely to the fabrication processes or the techniques for construction; and coordination of the work with other trades. Receipt or approval of shop drawings by the ENGINEER does not relieve the CONTRACTOR of the responsibility of complying with Contract Documents.
2. All shop drawings (drawings and manufacturer's data) required under each section of this Division 26 shall be submitted at the same time and be bound together in one hard back, three ring binders per copy, properly indexed for the formal submittal. Binder shall be sized to adequately contain all the materials therein and shall be labeled as to the identity of the job and the sub-contractor.
3. Shop drawings shall include functional and descriptive literature of the particular item furnished complete with dimensional drawings, wiring or schematic diagrams, rough-in and installation instructions, knock-out locations, hangers or mounting devices, etc., as required for the proper checking and installation of the equipment. Catalog sheets without any reference made to the particular item will not be acceptable. All special features called for in Contract Documents shall be noted. Where performance test results of a product design are called for in the technical sections of these specifications, test data sheets shall be provided with the shop drawing submittal.

B. Material Lists: Include manufacturer, type and model number of equipment that will be provided as called for under each section of this Division 26.

C. Other Information: As required by the ENGINEER.

1.5 CODES, LICENSES AND STANDARDS

A. Perform work in accordance with best present-day installation and manufacturing practices. Comply with all applicable laws, building and construction codes, and requirements of governmental agencies under whose jurisdiction work is being performed. Unless specifically

noted to contrary, conform with and test in accordance with applicable sections of latest revisions of the following codes and standards.

1. American Society for Testing and Materials (ASTM)
2. National Fire Protection Association (NFPA)
3. National Electrical Code (NFPA 70-NEC)
4. Insulated Power Cable Engineers Association (ICEA)
5. Underwriters Laboratories Inc. (UL)
6. American Steel and Iron Institute, "Design Manual on Steel Electrical Raceways"
7. National Electrical Manufacturer's Association (NEMA)
8. National Electrical Contractor's Association (NECA)
9. American National Standards Institute (ANSI)
10. International Building Code (IBC)
11. State of Nevada Electrical, Energy, Building and Safety Codes
12. Institute of Electrical and Electronic Engineers (IEEE)
13. Instrument Society of America
14. Wastewater Treatment Plants (NFPA-820)
15. US Environmental Protection Agency (EPA)

B. Conflicts Between Above Codes and Standards: The code or standard establishing the more stringent requirements shall be followed.
C. Conflicts Between Codes and Standards and Specifications and/or Drawings: The one establishing the more stringent requirements shall be followed.

1.6 MATERIALS AND WORKMANSHIP

A. Each type of equipment or material shall be the same make and quality. All materials and equipment shall be installed in accordance with the recommendations of the manufacturer as approved by the ENGINEER to conform to the Contract Documents.
B. The installation shall be accomplished by workmen skilled in the type of work involved.
C. All materials and equipment furnished and installed shall be of best quality, new, free from defects and meet the standards of NEMA, ICEA, UL, NFPA, IBC, OSHA, NEC, and shall bear their label wherever standards have been established and label service is available. Where materials and equipment are specified by manufacturer's name, the type and quality required is thereby denoted. The ENGINEER shall be afforded every facility, deemed necessary to observe and examine the materials and apparatus being installed to prove their quality.
D. Workmanship shall be the best quality of its kind for the respective industry crafts and practices, be neat and orderly throughout the project and shall be acceptable in every respect to the ENGINEER. Nothing contained herein shall relieve the CONTRACTOR from making good and perfect work in all details of construction.
E. The CONTRACTOR shall work in harmony with the ENGINEER and with other contractor's, companies or individuals working in connection with this project. Imperfections or discrepancies by other contractors shall not relieve responsibility of this CONTRACTOR. Store materials orderly and clean up without interference with other trades.

1.7 DEFECTIVE EQUIPMENT

A. If equipment fails to conform to detailed specifications or to operate satisfactorily, the OWNER will have the right to operate equipment until defects are corrected.

1. The OWNER will have the right to operate rejected equipment until it is replaced, without cost for depreciation use or wear.
2. Remove equipment from operation for examination, adjustment, alteration or change only at times approved by the OWNER.

1.8 STORAGE AND PROTECTION OF MATERIALS

A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work under way, and apparatus against loss or damage.
B. Materials and apparatus shall be stored with environmental protection and other necessary conditions as recommend or required by the manufacturers'.

1.9 RECORD DRAWINGS

A. The Contract Document drawings will be used by the CONTRACTOR who shall accurately and neatly mark in colored pencil all changes or deviations from the drawings as they are made in the work.
B. Refer to Section 01 70 00 Contract Closeout for additional requirements.

1.10 COORDINATION OF CONSTRUCTION

A. Coordinate work with other contractors, the OWNER, and the ENGINEER to assure orderly and expeditious progress of work. Select order of work and establish schedule of working hours for construction. This is subject to review by the OWNER if the work involved is part of a functioning facility. If such is the case, the CONTRACTOR shall carefully coordinate any disruption of service with the OWNER. Any after hours/weekend outages shall be accommodated at no additional cost to the OWNER.
B. The electrical work shall be laid out in advance of construction to eliminate unnecessary cutting, drilling, or channeling, etc. Where such cutting and drilling, or channeling becomes necessary for proper installation; perform with care, use skilled mechanics of the trades involved. Repair damage to building and equipment at no additional cost to the OWNER. Cutting work of other trades shall be done only with the consent of the CONTRACTOR. Cutting of structural members shall be done only with the written approval of the ENGINEER.
C. Comply with the following:

1. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

2. 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.
3. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.

D. Cooperate with other trades to coordinate locations of electrical devices and apparatus.
E. Perform for other trades the electrical wiring and connections, for all devices or apparatus where not specified herein or indicated on the drawings. Consult the architectural and mechanical drawings to avoid the location of switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc. Hidden electrical devices and/or connections shall be relocated as directed, at no additional cost to the OWNER.
F. Where conduit, outlets or apparatus is to be cast in concrete or encased, it must be located and secured by a journeyman or foreman present at the point of installation. He shall check the locations of the electrical items before and after the concrete and masonry installation and shall relocate displaced items at no additional cost.

1.11 USE OF SUBSTITUTES

A. Equipment and materials are designated by one or more manufacturer's name brands or numbers. It is not the intent of the specifications to exclude other equipment or materials that equal or exceed the standard of those specified. If the CONTRACTOR desires to use substitute equipment or materials, he must submit for written approval as outlined in the General Conditions of the Contract Documents.

1.12 SITE CONDITIONS

A. Examination of Site: Examination of the site shall be made by the CONTRACTOR, who shall compare it with the drawings and specifications and satisfy himself as to the conditions under which the work is to be performed. He shall, at such time, ascertain and check all conditions which may affect his work. No allowance shall subsequently be made in his behalf for any extra expenses to which he may be put due to failure or neglect on his part to make such examination.
B. Review of Plans: Review all work indicated on drawings and specified herein with proper authorities responsible for interpreting applicable codes, ENGINEER, and local inspector prior to commencement with construction as listed herein, but not necessarily limited thereto:

1. Visit site prior to executing bid.
2. Verify measurements and locations of field measurements of existing conditions and those developed by construction.
3. Confirm requirements of work at off-site, publicly owned property with local authorities
4. Confirm connection requirements, sizes and layout with local public utilities.
5. Conditions discovered in conflict with intent of drawings and/or specifications must be clarified with ENGINEER prior to execution of work.

1.13 CLEAN-UP

A. As the work progresses and on a daily basis, the CONTRACTOR shall remove from the premises and surrounding streets, alleys, etc., all rubbish and debris resulting from his operations and shall leave all equipment and material furnished by him absolutely clean and ready for use.

1.14 SUPERVISION

A. A competent foreman or superintendent initially approved by the ENGINEER shall be at the site at all times to receive instructions and shall be empowered to act. He shall verify dimensions given on the drawings and report any discrepancies or inconsistencies to the ENGINEER before commencing the work. The ENGINEER, or his representative, will interpret the meaning of the drawings and specifications where questions arise.

1.15 SAFETY REGULATIONS

A. The CONTRACTOR shall comply with OSHA and all other safety codes required by law and shall furnish and place proper protection for prevention of accidents. He/she shall provide and maintain any necessary construction required to secure safety of life or property during the performance of his/her work, including the maintenance of sufficient lights to secure such protection.

1.16 DISPOSITION OF EXISTING EQUIPMENT REMOVED FROM SERVICE

A. Existing equipment and materials such as cables, switches, conductors, etc., which are removed and not reused in the new installation shall remain the property of the OWNER. The CONTRACTOR shall deliver such equipment to storage place as directed. Items not wanted by the OWNER shall be removed from the site and disposed of by the CONTRACTOR.

1.17 PERMITS AND FEES

A. Obtain all permits and pay all fees for inspections, required by code for all the work covered under Division 26 of the specifications. All fees shall be included in the contract price. The CONTRACTOR shall furnish a certificate of approval to the ENGINEER from each inspection authority at completion of the work.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 FIELD DESIGN CHANGES

A. No field changes, additions, or change in locations shall be made without written approval from the ENGINEER.

3.2 EXCAVATION AND BACKFILLING

A. The CONTRACTOR shall perform all excavation, trenching and backfilling work, and remove all debris in connection with his work. Backfilling shall be done with materials acceptable to the ENGINEER and thoroughly tamped in place. All disturbed surfaces shall be restored to their original condition and properly installed to eliminate any settlement. Inside and outside, backfill shall be in 6-inch layers, compacted to 95% of the "standard protector test".

B. Perform excavation in a manner to protect walls, footings and other structural members, from being disturbed or damaged in any way.

3.3 ROUGH-IN REQUIREMENTS

A. Architectural, structural and mechanical drawings shall be continually consulted and referred to. Exact placement of sleeves, conduit, and equipment shall be provided for by checking building and equipment dimensions. Equipment requirements and dimensions related there to shall be determined from detailed rough-in dimensions of each piece of equipment shown on Shop Drawings furnished by manufacturer.

3.4 CUTTING AND PATCHING CHASES AND OPENINGS

A. Provide for all required cutting and patching, anchors, openings, slots, chases, etc., in construction for electrical work. Cutting and patching performed under direction of CONTRACTOR and will leave no discernable scars.
B. The CONTRACTOR shall be responsible for block-outs or demolition work pertaining to the installation of the electrical system.
C. In Remodeling and/or Addition projects, all salvageable electrical equipment and materials that cannot be integrated into the new electrical network becomes the property of the OWNER. Remove from the premises materials which the OWNER decides not to keep, as directed by the ENGINEER.

3.5 WORKMANSHIP

A. The CONTRACTOR shall be held solely responsible for the proper installation of his work. He shall arrange with the proper contractors for the building in of anchors, etc., and for the leaving of required chases, openings, etc., and shall do all cutting and patching made necessary by his failure or neglect to make such arrangements with others. Any cutting or patching done by this CONTRACTOR shall be subject to the directions of the ENGINEER and shall not be started until approval has been obtained.
B. All cutting, welding or drilling of concrete or structural members shall be properly reinforced and patched to match as nearly as possible the surrounding work. Before cutting, welding or drilling any concrete or structural member, the CONTRACTOR shall secure the approval of the ENGINEER.
C. This CONTRACTOR shall assign persons in direct charge of work who are thoroughly experienced in the class of construction work specified herein. All labor shall be performed in a workman like manner by skilled workmen under the supervision of competent foremen.
D. This CONTRACTOR shall periodically remove all debris and waste in order to maintain safe working and operating conditions, and shall dispose of the same in an approved manner. At the completion of work, he shall remove all his rubbish, tools, scaffolds and surplus materials from and about the site, leaving his work clean and the areas ready for occupancy.

3.6 SEISMIC RESTRAINT

A. The International Building Code requires that not only the structure, but also major mechanical and electrical components be designed and installed in a manner which will preclude damage during a seismic event. All electrical equipment shall be securely anchored and seismic braced in accordance with regulations contained in the most recent adopted edition of the IBC, and SMACNA "Guidelines for Seismic Restraints of Electrical Systems".
B. Units mounted and secured directly to structure shall be provided with connectors of sufficient strength to meet the restraining criteria.
C. All electrical equipment which is securely anchored (hard mounted) to the building or structure shall have supports designed to withstand lateral and vertical "G" loadings equal to or greater than IBC requirements and SMACNA guidelines.
D. Shop drawings are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, load/deflection data, center of gravity, standard connections, manufacturer's recommendations, and behavior problems (vibration, thermal, expansion, etc.) associated with equipment so that the final design can be properly reviewed.

3.7 TESTS

A. On completion of the work, the installation shall be tested free from all grounds and short circuits.
B. Normal feeders, circuits, and service entrance conductors with wire size #2 and larger shall be tested for leakage phase-to-ground and phase-to-phase prior to energizing the electrical system. The CONTRACTOR shall submit a written report to the ENGINEER showing methods and readings taken. Voltage applied for testing shall not exceed two times normal operating voltage.
C. Submit a record of voltage readings and amp meter readings on all feeders, motor full load amps, outside lighting, and service conductors to the facility. If there are any abnormal conditions, they shall be brought to the attention of the ENGINEER in writing as a part of this submittal.

3.8 SUBSTANTIAL AND FINAL COMPLETION

A. Notify the ENGINEER when work is considered to be complete, in operating condition, and ready for Substantial Completion.
B. The ENGINEER, after determining that installation is ready for Substantial Completion, will make walkthrough and perform operational tests deemed necessary to determine that provisions of specifications are satisfied and prepare a list of outstanding items.
C. The OWNER will not accept work nor make final payment to CONTRACTOR until ENGINEER has certified that work of CONTRACTOR is complete and in conformance with specifications and guarantees.
D. Leave the job in complete order ready for use. All fixtures and equipment shall be tight, fully equipped and completely cleaned. All equipment shall have been operated, checked and approved by the OWNER before the project can be accepted.

E. At the time of the substantial and final walkthroughs, the project foreman shall accompany the party and remove cover plates, panel and enclosure covers, and other access panels for the ENGINEER, to allow complete observation of the entire electrical system(s).
F. Notify the ENGINEER when work is considered to be complete, including list of outstanding items, and is ready for Final Completion. Refer to Section 01 70 00 Contract Closeout for additional requirements.

3.9 TRAINING

A. Instruct OWNER's operating personnel in proper operation of the complete electrical system including all electrical equipment, switching, disconnects, panels, controls, etc., during a scheduled training tour for the OWNER's personnel of entire project after Substantial Completion and prior to Final Completion. Confirm complete understanding on part of OWNER's operating personnel. Utilize the Operations and Maintenance Manuals specified elsewhere during the instruction process.

3.10 GUARANTEE/WARRANTY

A. The following guarantee is a part of the specification and shall be binding on the part of the CONTRACTOR and shall be submitted by letter to the OWNER prior to acceptance.
B. The CONTRACTOR guarantees that this installation complies with the drawings and specifications in all respects, and is free from defects. He agrees to replace or repair, to the satisfaction of the ENGINEER, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after Final Completion.
C. The CONTRACTOR guarantees that the installation of OWNER furnished equipment is free from defects. He agrees to provide labor to repair or replace to the satisfaction of the ENGINEER any part of his installation of the OWNER furnished equipment (the respective equipment vendor will provide all parts and labor for the equipment), which may fail or be determined to be unacceptable within a period of one (1) year after Final Completion.
D. Electrical and instrumentation systems and equipment shall not be considered acceptable for Substantial Completion until they have performed in service continuously without malfunction for at least ten (10) days.

- END OF SECTION -

SECTION 26 05 05
OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
B. Division-26 Electrical General Requirements sections apply to work of this section.

1.2 SUMMARY

A. Furnish four sets of bound operation and maintenance manuals. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.
B. Refer to Section 01 34 00 for additional requirements.

1.3 OPERATION AND MAINTENANCE MANUAL FOR ELECTRICAL AND INSTRUMENTATION SYSTEMS

A. General:

1. The "Operating and Maintenance Manual" (Electrical and Instrumentation) is a bound compilation of drawings and data that the owner requires for each building or project. These manuals, complete with drawings and data, shall be furnished to the Owner.
2. The electrical CONTRACTOR has overall responsibility to obtain the necessary data and compile the data as set forth in this specification, including items or equipment purchased by the Owner and delivered to the CONTRACTOR for installation.
3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.02A.
4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.

B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

PART 2 PRODUCTS

2.1 PAGE SIZE

A. All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 11 x 17 inches) folded to 8-1/2 x 11 inch.

2.2 DRAWINGS

A. All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

2.3 BINDERS

A. Binders shall be Buckram (stiffened fabric), bar-lock type binders with block lettering for sheet size 8-1/2 x 11 inches with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, however, shall be based on not filling them beyond 4".
B. Place the following information on the front cover and backbone:

1. "Operation and Maintenance Manual".
2. Project Name and Number (and volume number if more than one volume).
3. Equipment name and number.
4. ENGINEER's name.
5. General CONTRACTOR's name.
6. Electrical CONTRACTOR's name.

(Items 4 through 6 need not be printed on the backbone.)

2.4 CONTENTS AND INDEXING

A. Manuals shall contain descriptions of the electrical, control, and instrumentation systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.
B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.
C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:

1. Copy of purchase order change (if any).
2. Outline drawings, special construction details, “as-built” electrical wiring and control diagrams with wire and terminal number for panel and field wiring for all major and supplementary systems.
3. Manufacturer’s test or calculated performance data and certified test curves.
4. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.

5. Manufacturer's brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.
6. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
7. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:
   a. Part I Building and System Descriptions
   b. Part II Purchased Equipment Data
   c. Part III Test Reports and Charts
   d. Part IV Start-Up and Operation
   e. Part V Preventative Maintenance Recommendations
   f. Part VI Software/Programming Data/Program CD's
8. A copy of the approved submittals for each piece of equipment.
9. A copy of all testing reports.
10. Wiring diagrams, marked with model and size and plan symbol.
11. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.
12. Copies of developed software, programmed setpoints, screens, etc. on C.D.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 07
ELECTRICAL POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. The General Contractor shall provide electrical power system studies for the project. The General Contractor shall hire the engineer of record, engage the manufacturer, or a third-party PE to perform the studies. The type and content of each study is specified in the following articles.

1.2 SUBMITTALS

A. Completed electrical power system studies shall be bound and submitted to the ENGINEER.

1. Five (5) printed copies (hardcopies) of the completed study report shall be provided and one (1) copy in Microsoft Word or Adobe Acrobat format.
2. The software database and library used to model the power system shall be submitted in native file format including all updates to the library necessary to complete the model.

B. The CONTRACTOR shall attach brochures, resumes, references and other information indicating how your firm is qualified to provide the services outlined in this document.

C. The CONTRACTOR is responsible for compliance with all performance specifications in this proposal. Any deviation from complete compliance must be noted on the performance specification submitted for review and approved before work begins.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The analysis software shall be SKM Analysis Software or equal meeting all performance specifications.

2.2 ELECTRICAL POWER SYSTEM STUDIES

A. An electrical arc flash hazard analysis, including:

1. The development of an up-to-date electrical system one-line diagram and model to provide staff members with an accurate representation of the installed electrical system.
2. Determination of system operating modes and conditions that can impact short circuit currents and arc flash hazard energy levels.

3. Short circuit and equipment duty study to verify that equipment is rated to safely handle short circuit currents without creating hazardous conditions.
4. Protective device coordination study and review to help ensure proper electrical system reliability and to determine if arc flash hazard energy levels can be reduced.
5. Arc flash hazard analysis study to determine arc flash energy levels and Personal Protective Equipment (PPE).
6. Power System Modeling and Arc Flash Analysis software for ongoing use by the staff members maintaining and updating the system study as the plant changes.
7. Arc flash and safety program implementation software for ongoing use by the staff members for arc flash and safety program management and tracking.
8. Arc flash hazard labeling.
9. Assistance with the development of Energized Work Permits.
10. Arc flash and electrical safety training.
11. Personal Protective Equipment (PPE) training.

B. An electrical arc flash hazard analysis shall be performed to determine incident energy, arc flash protection boundaries, and required PPE for all electrical equipment in the facility. The calculations shall comply with NFPA-70E 2004, and IEEE-1584-2002. An integral part of NFPA-70E compliance is integrating work permits with arc flash assessment for all equipment in this facility. This section describes in detail the requirements for the study as well as integrating work permits in the system model for 70E compliance.

C. The purpose of this study is to provide a comprehensive software model of the electrical distribution system, which will document facility compliance with NFPA 70E mandates as described below. This model will serve as an integral part of an ongoing safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E 2004 Article 130.1(A)(2) for each electrical equipment in the facility.

1. Article 205.3, 120.2(F)(1): Updated and verified one-line diagram for all electrical distribution voltages including all sources for lock-out and tag out procedures.
2. Article 400.5, 400.6: Updated short circuit and equipment duty verification study showing all electrical equipment is properly rated to withstand and interrupt the available short circuit duty per ANSI Standards and NEMA/UL/NEC requirements.

3. Article 400.6, 410.9: Updated protective device coordination study showing the system protective devices are properly set to coordinate and clear a fault without extensive equipment damage or personnel risk.
4. Article 130.3(A)(B), 110.8: Updated arc flash study providing maximum incident energies, arc flash boundaries, and PPE requirements for each equipment in the system. In addition, these calculations shall be integrated with 70E compliant work permits as part of an ongoing safety program.
5. Article 130.16(E), 400.11, 400.14, 400.21(C)(2), 410.8: Updated labeling displaying the worst-case arc hazard values for each equipment in the facility.

D. The analysis shall consist of the following:

1. Field data collection by qualified personnel (as defined by NFPA 70E).
2. Data entry and system one-line modeling in commercially available power system software.
3. Model verification.
4. Short Circuit and equipment verification study.
5. Protective device coordination study.
6. Arc flash hazard study.
7. Detailed report and findings of the analysis.
8. Electronic copies of the Project Report and the System Modeling File.

E. The analysis and procedures shall comply with the following standards and recommended practices for power system studies.

1. NFPA-70E, 2004 Standard for Electrical Safety in the Workplace
2. IEEE-1584-2002
3. IEEE-242 “Buff Book” Protection and Coordination of Industrial Power Systems
4. IEEE-399 “Brown Book” Power System Analysis
5. IEEE-141 “Red Book” Electric Power Distribution for Industrial Plants

2.3 DATA COLLECTION

A. Field data collection shall be performed by qualified individuals (as defined by NFPA 70E – 2004) to ensure accurate equipment modeling.
B. Field data collection and system modeling shall be based on the system installed.

C. Equipment shall be visually inspected to collect the necessary nameplate data used in the analysis, including transformers, switchgear and breakers, relays, direct-acting trip units, etc. Data that may not be readily accessible or may not have nameplate data such as conductors, busway, etc. can be taken from drawings.

D. Data collection shall include the step down transformer from the utility service (including primary relaying) down through each 480-volt motor control center (MCC) and 240/208 volt panels for all systems served by transformers rated greater than 125 kVA as per IEEE-1584-2002.

E. The CONTRACTOR shall obtain from the utility the minimum, normal, and maximum operating service voltage levels, three-phase short circuit MVA and X/R ratio, as well as line-to-ground short circuit MVA and X/R ratio at the point of connection as shown on the drawings.

2.4 SYSTEM MODELING

A. The system model shall be developed using a commercially available, fully integrated software package that meets the performance specifications developed in this Section. To ensure compliance with NFPA-70E 2004, ANSI, and IEEE Standards, and OSHA mandates, no exceptions or substitutions to the performance specification are allowed.

B. The system model shall be laid out in one drawing/view and in a manner that provides for easy viewing of all analysis results. The one drawing/view requirement ensures that problem areas found and highlighted by the program are easily seen and not hidden or buried in multiple drawings, eliminating potential human errors where multiple drawing verification is required.

C. All one-line symbols shall be spaced properly to facilitate viewing results on the one-line.

D. Equipment names used in the modeling software shall be identical to the equipment and naming convention shown on the drawings and equipment unless conflicts exist. The CONTRACTOR shall bring all naming convention conflicts or deficiencies to the attention of the ENGINEER for clarification.

E. The facility may have multiple operating conditions, including, but not limited to, generation on/off, shutdown, bus-ties, start-up, emergency operation, etc. Each of the operating modes shall be documented and modeled in the software in order to determine the worst-case arc flash hazard and associated parameters for the electrical equipment. For the purpose, assume that up to four (4) operating modes are possible.

F. The software shall model each operating mode in a manner such that each mode is a scenario or change case from the base case. Each scenario shall be a simple differential algorithm storing only the difference from the base case and the scenario. Modifications to the base case model shall automatically update all scenarios to eliminate the necessity to store complete databases for each condition, providing for a manageable file size that can be Emailed and eliminating the associated time, man hours, and errors with updating each database individually.

G. Project files created by the software shall be single files and not project directories containing multiple files. The file shall be self-contained and have all necessary information to describe the one-line, system data, settings, and analysis information. Files shall be easily transferable to any site via Email or disk and operable with no setting changes to the database file to eliminate the maintenance and administrative problems associated with multi-file project directories, and to provide an easy method to transfer the file for engineering review.

H. The software shall accurately model daisy-chained MCC's, panels, and sub-transformers without the use of intermediate buses, nodes or fake impedances.

I. Lumped motor groups for MCC's shall be modeled per IEEE standards using groups >50 Hp, and <50 Hp. Where motor list data is not available, single lumped groups may be modeled per IEEE-141 "Red Book".

J. Medium voltage motors greater than 1.0 kV shall be modeled individually on their respective buses including all protective phase and ground overcurrent relays and fuses. This model will provide individual work permits for each starter/motor on the one-line.

K. All low voltage power circuit breaker (LVPCB), insulated case (ICCB), molded case (MCCB) and fuse data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.

L. All relay data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.

M. All overcurrent relay types for the distribution system shall be modeled on the one-line diagram (and database) including phase and ground overcurrent, differential, residual, ground neutral, etc. to establish a complete and detailed system model where protective device data can be easily modified and updated by the facility and all data is available for a comprehensive protective device coordination study if required in the future.

N. Relay models shall depict the actual connection requirements. See Figure-1.3M. Programs using symbols as shown in Figure-1.3M(na) are not acceptable since they do not depict the actual system and can lead to confusion in determining arc flash results and proper protective device modeling.

O. Multi-function relays shall have all their overcurrent devices modeled in a single device and shall be able to accept multiple CT's.

P. All equipment modeling must have a corresponding one-line diagram symbol. This means that there can be no hidden database models. The purpose is for the facility to easily see all equipment, its associated data, to be able to link documents to the equipment as a data repository, etc. and to see problems right on the one-line.

Q. All system modeling shall conform to accepted modeling practices as outlined in IEEE-399 “Brown Book”. Contractor/consultant may provide more advanced modeling techniques where compliance with the specification is maintained.

2.5 MODEL VERIFICATION

A. The system model shall be verified by reviewing the results of short circuit current flows for all buses/equipment in the system. The results shall be viewed on each branch and total flow into a bus/equipment on the system one-line diagram. The purpose is to visually spot check values with recognized industry benchmarks as to the expected amount of short circuit current, and correct any problem areas.

2.6 SHORT CIRCUIT STUDY

A. A short circuit study shall be performed to verify all equipment duties in the system. The calculations shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The short circuit study shall verify the system electrical equipment is properly rated to withstand and interrupt the expected bolted and arcing faults in the system. Improperly rated and applied equipment may not protect personnel against arc flash hazards even if properly applied PPE is used. The software program must comply with the above standards in order to properly verify equipment installed in North America. No substitutions will be allowed.

B. The equipment duty verification shall determine both the line side and load side fault current through each equipment and use the highest current to verify equipment ratings. Standard bus faults are not acceptable for protective devices in that they do not accurately model the current through the device and consequently they provide erroneous results. For solidly grounded systems, both three-phase and single-line-to-ground faults should be modeled. For other grounding configurations only a three-phase fault is required.

C. Equipment duty results shall be graphically displayed on the electrical one-line as well as tabular report format.

D. The results of the equipment duty verification tabular format report shall provide the following data:

1. Equipment name and kV
2. Manufacture, type, style, and ratings of the device
3. Actual line or load side currents through the device and percent over/under duty
4. Flag for the device showing VIOLATION or WARNING level for visual identification

E. A report of all problem areas shall be provided. Contractor shall notify the project management corporation – and owner facility personnel immediately of all problems found in this system before proceeding in the study. A recommended action list shall be provided for all underrated equipment in the system.

2.7 PROTECTIVE DEVICE COORDINATION (PDC) STUDY

A. A PDC study shall be performed in order to determine if the system protection characteristics are sufficient to provide reliable power to the facility. The PDC study will also determine if the settings entered in the software will provide proper personnel protection in the arc flash portion of this study. For facilities where the main distribution is low voltage (under 600 volts) and only instantaneous breakers or fuses are used, this section may not apply.

B. The PDC study shall consist of system feeders and branch circuits 100amps and larger, and plotting the time-current curves (TCC's) to verify proper selective operation of the protective devices. The study should also determine if the settings can be enhanced to provide increased personnel/equipment protection without sacrificing selective coordination.

C. The CONTRACTOR shall notify the ENGINEER of any potential problems in the protective device settings that affect either selective operation and reliability or personnel protection and shall provide recommendations for changes in writing before continuing with the study.

D. As specified in the data collection and modeling sections, all PDC data shall be modeled on the one-line diagram and in the equipment database.

E. The CONTRACTOR shall contact the serving utility and obtain protective device settings for all service entrance over current devices in series with the facility and affecting coordination with facilities distribution system.

F. TCC Specifics: The TCC's shall graphically illustrate on log-log paper that adequate time separation exists between series devices. The specific time - current characteristics of each protective device shall be plotted in such a manner that sufficient upstream devices will be clearly depicted on one sheet to prove selective coordination.

1. TCC's shall include a system one-line diagram and protective device coordination curves for each device in the selected area. The TCC shall be printed in color on 8 ½ x 11" paper – full size portrait mode, using a log-log scale. The one-line diagram shall be part of the TCC and include all protective devices, equipment names, and short circuit currents calculated from the main one-line. The purpose of this requirement is to provide all necessary information on one sheet, in a format easily readable and standard to the industry.

2. For low voltage systems, TCC's shall be developed for both phase and ground protective devices. One phase and one ground TCC should be developed for each unit substation. The TCC should show the largest feeder/motor protective device in the MCC or panel up through the switchgear/switchboard feeder breaker, transformer secondary main, unit substation primary fuse, and medium voltage feeder breaker. For secondary switchboards serving large loads or a wide variety of loads that may affect upstream coordination, additional TCC's may be required.
3. For medium voltage systems, TCC's shall be developed for both phase and ground protective devices. The TCC should show the largest feeder/motor protective device in the lineup up through the switchgear/transformer secondary main, unit substation primary fuse, and medium voltage feeder breaker.
4. The following specific information shall also be shown on the coordination curves:

    a) Device identification.
    b) Voltage and current ratio for curves.
    c) Transformer three - phase and single-line-to-ground ANSI damage curves.
    d) Transformer inrush points.
    e) Minimum melting, and clearing curves for fuses, and if available the no-damage curve.
    f) Cable damage curves.
    g) Motor starting locked rotor curves, and if available the motor locked rotor damage point.
    h) Maximum short circuit cut-off point.
    i) Clearly marked short circuit current levels through each protective device/branch, which should be based on the appropriate current through the device, i.e. Momentary, Interrupting or 30 Cycle current.
    j) Protective device one-line diagram clearly showing all protective devices on the time-current curve, labels for each device, open breakers, faulted buses, and the short circuit current flowing in each branch.
    k) Each TCC sheet shall have appropriate identification and a one-line diagram that applies to the specific portion of the system associated with time-current curves on that sheet.

l) Each protective device curve shall be terminated at a point reflecting maximum symmetrical or asymmetrical fault current through the device.

m) Identify the device associated with each curve by manufacturer type, function, and setting – i.e. tap, time delay, and instantaneous, pickup, etc.

n) Primary Protective Device Settings for Delta-Wye Connected Transformer:

1) Secondary Line-To-Ground Fault Protection: Provide primary protective device operating band within the transformer's characteristics curve, including a point equal to 58 percent of ANSI C57.12.00 withstand point.

2) Secondary Line-To-Line Faults: Provide 16 percent current margin between primary protective device and associated secondary device characteristic curves.

o) Typical time separations for curves:

1) Consultant/contractor shall discuss the advantages and disadvantages of various time separation settings between device curves with the project management company and owner facility personnel to help determine how the system settings shall be optimized for selectivity and arc flash hazard reduction.

G. A setting table shall be developed to summarize the settings selected/existing for the protective devices. The table shall include the following:

1. Device identification.
2. For low voltage breakers, the circuit breaker manufacturer, type, and style, sensor rating, long-time, short-time, instantaneous settings, and time bands. For breakers with ground fault capability, the pickup and time delay.
3. Fuse manufacturer, type, style, and rating.
4. Protective relay manufacturer, type, style, function (51, 50, 67, etc.) pickup, current multiplier, time dial, and delay. For multi-function units, list all devices being used. Include the CT and/or PT ratios for each function.

H. The software shall provide complete integration of the one-line, database, short circuit, protective device coordination and arc flash analysis functions to provide accurate calculations and avoid errors and inefficiencies associated with multiple data entry programs. Programs using separate PDC or TCC plotting packages are not allowed. Complete PDC integration is defined as the following:

1. TCC's shall be developed by simply selecting (highlighting) with the mouse the one-line area to be coordinated. The TCC shall automatically be plotted for the selected area including all short circuit levels. The TCC plot shall automatically include the selected one-line area in a drag and drop window on the TCC showing all one-line attributes without user additions required. These attributes shall automatically include all short circuit currents and voltages displayed on the main one-line, equipment names, etc. and update automatically without additional user input.
2. Programs requiring the user to build a separate TCC one-line are not integral with system short circuit calculations and do not automatically update as the system one-line changes, requiring additional man-hours for one-line development and are consequently prone to errors as the system changes. These types of programs shall not be considered for the study.
3. Each TCC shall have momentary (1/2 cycle), interrupting (1-4 cycle), and 30 cycle short circuit currents (tick marks) displayed on the TCC plot for each protective device or as required to properly model the tripping characteristics of the device. The tick marks shall be user adjustable for visual appearance. The purpose is to provide accurate tripping currents for each device.
4. The software model shall allow each protective device to model momentary (1/2 cycle), interrupting (1-4 cycle), and 30 cycle short circuit currents simultaneously depending on the characteristics of the device.
5. The software shall model remote voltages and currents for any single fault and display them on the TCC showing all trip cutoffs based on the remote currents. The purpose is to accurately model and verify backup relaying to ensure selective operation under all fault conditions. PDC programs that perform only batch faults, or fail to model remote voltages and currents for all fault types shall not be considered.
6. The software shall model and display time difference calculations for any selected pair of protective devices. The difference calculator shall include bracketing bars with the calculated difference to clearly show the selective time between the devices. The calculated time shall update dynamically for instant visual setting as the devices are dragged (settings modified). In addition, tool tips shall clearly show the time difference and the protective device settings for all devices as they are dynamically changed or set to allow the user to accurately determine the proper setting between devices in the most efficient manner, reducing coordination time and providing more accurate results.
7. The software model shall provide for WYSIWYG drag and drop modeling of all protective devices and provide for tool tips and notes to display all settings dynamically. The purpose is to provide accurate adjustments and settings in the most time efficient and accurate manner.

8. TCC's shall have the ability to display short circuit currents and arc flash hazard results within the fully integrated system one-line in the PDC focus. Short circuit currents are available at any equipment with a single mouse click. Short circuit currents and arc flash hazard values shall change on the fly as the protective device settings change, allowing the user to instantly see the results of PDC changes and the associated impact to short circuit currents and arc flash hazard values.
9. The software model shall provide a detailed library for the most common protective devices available in North America. The library shall be user definable.

2.8 ARC FLASH STUDY

A. A detailed arc flash study shall be performed to determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protective equipment (PPE) for all energized electrical system equipment tasks for the electrical system studied. The calculations shall comply with NFPA-70E 2004, and IEEE-1584. Bolted short circuit calculations used in the above standards shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The purpose of this study is to determine arc flash hazards in conformance with NFPA-70E and to facilitate a safety program for the OWNER, and to provide a comprehensive software model of the electrical distribution system, which provides integral work permits and arc flash calculations in compliance with NFPA 70E Article 130.1(A)(2) for all equipment in the facility. The software program used in this study shall comply with the above standards. No substitutions in calculation methods will be allowed.

B. The arc flash study shall determine the following results for each system mode of operation. The results shall be provided in spreadsheet format for each mode and electrical system location to provide easy viewing and comparison. Worst-case arc flash energy levels shall be flagged and the spreadsheet comparison table shall be capable of providing its output directly to high quality vinyl label printers. The calculations shall, as a minimum, include a comparison of both 100% and 85% arcing currents for low voltage equipment for each electrical system configuration or operating mode, indicating worst-case arc flash hazards. The spreadsheet results shall include:

1. Equipment name and voltage.
2. Upstream equipment device name and ANSI function, i.e. 51/50, etc.
3. Equipment type, i.e. switchgear, MCC, Panel, VFD, etc.
4. Equipment arc gap.
5. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current should be based on the arcing current equations used.

6. Trip time, opening time, and total clearing time (total Arc time) of the protective device.
7. Worst-case arc flash boundary for each bus/equipment in the model.
8. Worst-case arc flash hazard incident energy in cal/cm^2 for each bus/equipment in the model.
9. Worst-case personal protective equipment (PPE) for each bus/equipment in the model.
10. Working distances for up to five different distances showing items 7, 8, and 9 for each distance.
11. Indicate "Danger/Hazardous" areas where incident energy is greater than 40 cal/cm^2 and provide recommendations to reduced arc flash energy levels for these areas.
12. Flag results where 85% arcing current provided worst-case results.

C. Each mode of operation shall include a detailed write-up indicating areas where incident energy calculations and PPE requirements are higher than calculated in the normal operating mode.

D. Consultant/contractor shall provide a detailed arc flash analysis report including as a minimum:

1. Introduction.
2. Methodology.
3. Information Sources.
4. Key Assumptions.
5. Arc Flash Energy and other consideration for various System Modes of Operation (maintenance mode, bus-tie, co-gen on/off, etc.).
6. Arc Energy at 100% and reduced currents.
7. IEEE 1584-2002 Considerations.
8. Overcurrent Protective Device Changes, Replacements or Setting Changes implemented in study to reduce arc flash hazard exposure.
9. Explanation of Data in Arc Flash Hazard Report Tables.
10. NFPA 70E Information.

    a) Shock Hazards with covers removed.

b) Shock Hazard Approach Boundaries.

1) Limited Approach Boundary.
2) Restricted Approach Boundary.
3) Prohibited Approach Boundary.

c) Arc Flash Hazard Boundaries.

11. Results of Arc flash Hazard Analysis for high voltage, medium voltage and low voltage systems, including:

a) Working distances.
b) Energy Levels.
c) PPE Requirements.
d) Recommendations to reduce arc flash hazard energy and exposure.

12. Arc Flash Hazard Report.

a) 5 Hard Copies.
b) 1 Electronic Copy in Adobe Acrobat format (5.0 or later).

13. Electronic file for Power System Modeling Software as developed and utilized for this analysis.

E. The CONTRACTOR shall provide printed labels for labels for all equipment in the system from the project study file. Assume three (3) labels per equipment/bus in your estimate using 4” x 6” labels or one (1) 6” x 8” label per equipment bus. The labels shall be UV resistant vinyl labels (white with orange warning strip and black letters) conforming to ANSI-Z535. The labels shall be printable directly from the power system software utilized for the study with a Duralabel, Brady PowerMark or GlobalMark printer to ensure that the OWNER’s personnel have the option of printing the labels without the extra expense of going to an outside printing service, converting arc flash results to spreadsheet format or performing tedious manual data entry.

F. Software Requirements: The software shall provide complete integration of the one-line, database, short circuit, PDC and Arc flash functions. Software using separate short circuit, PDC, TCC or arc flash programs is not allowed. Spreadsheet calculations are not allowed. The purpose of this section is to ensure that the arc flash hazard calculations comply with NFPA-70E and IEEE-1584, and that the calculations are programmed with necessary requirements to help eliminate possible errors in the arc flash calculations. The additional purpose is to establish a detailed software model of the project management company and owner facility electrical distribution system, which will document compliance with the OSHA requirements and NFPA 70E mandates. This model will serve as an integral part of the OWNER's safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E Article 130.1(A)(2) for each electrical equipment in the facility.

1. Arc flash calculations shall be performed with enhanced IEEE-1584 equations, which eliminate voltage discontinuities and the non-conservative/average results of the standard equations. The purpose of this requirement is to ensure that the calculated incident energies are closer to actual test results insuring a conservative calculation minimizing personnel risk.
2. Arc flash calculations shall be based on the fastest clearing upstream protective device protecting the equipment for single sources and the slowest upstream protective device for multiple sources. The calculations shall automatically compare all series and parallel upstream protective devices in the system to determine the fastest series device or a conservative parallel clearing time. The algorithm shall incorporate a traversing routine that can search back an unlimited number of buses/nodes and consider all series and parallel branches in the comparison to ensure accurate answers and to prevent hazards associated with incorrect results. Software shall not have trace back limits (5-10 buses) that can provide incorrect answers for low voltage faults that require high voltage protective device clearing to prevent potential errors.
3. The arc flash calculations including arc flash boundary, incident energy, PPE requirements, and working distance shall be displayed on the software one-line diagram and TCC simultaneously. The software must show visually the arc flash values as the settings are incrementally changed (dragging curves) so the protection can be optimized in the most efficient manner, allowing the protection engineer to visually balance the competing objectives of personnel protection with that of system selectivity.
4. The arc flash calculations shall include four (4) calculation options to ensure that the software provides the flexibility required to meet any system configuration or training requirement that may be considered. Each calculation option shall comply with the graphic and spreadsheet display requirements of this section. Each option is more specifically described below.

a) The detailed option shall provide the let-through energy for each protective device in the system. This is the energy on the load side of the protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.
b) Worst-case including main protective device. This option shall provide the worst-case arc-hazard energy for the equipment based on the let-through energy of the equipment's main protective device. If the equipment is not equipped with a main device, the program must traverse back the entire system to determine the fastest series upstream protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.
c) Worst-case excluding main protective device. This option shall provide the worst-case arc-hazard energy for the equipment based on the let-through energy of the fastest upstream series protective device in the system. The program shall traverse back the entire system to determine the fastest upstream protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.
d) Worst-case excluding and including the main protective device. A combination of options 'b' and 'c' as stated above.

5. The arc flash calculations shall provide integral "Work Tasks" for the listed equipment types. The tasks shall be derived from 70E Table 130.7(C)(9)(a) and be specific to the equipment type. Work tasks shall be user definable in the software to allow customization and integral with the "Work Permit" feature of the software. Listed equipment types shall include:

a) Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 100-200 volt equipment.
b) Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 200-1000 volt equipment.
c) Switchgear, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 1.0-5.0 kV equipment.
d) Switchgear, MCC, VFD, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 5.0-15.0 kV equipment.
e) Switchgear, Interrupting Switch, Conductor, Open Air for 15.0-38.0 kV equipment.
f) Interrupting Switch, Conductor, and Open Air for 38.0-1500 kV equipment.

6. Work Tasks shall have a user-defined library that provides the following customizable features for each work task:

    a) Work Tasks for each specific equipment type and voltage range.
    b) Working distance units English or Metric.
    c) Work distance for each task.
    d) V-rated gloves and tool requirements.
    e) Job description and procedures.
    f) Safe work practices description.
    g) Hazard Risk Category (HRC) reduction. *Note: HRC reduction can only be used based on a documented risk assessment as an integral part of a safety program.

7. Work tasks shall be accessible from the one-line diagram for any equipment through a mouse click on the equipment in the electrical system model one-line. A dialog box shall appear listing all 70E and user definable work tasks for the specific equipment selected. The work task dialog shall include a user definable working distance for each work task and allow the user to select tasks specific to any equipment feeder or the incoming main. Work tasks for each equipment type shall be voltage specific and user definable in the library. The purpose of these requirements is to integrate 70E work tasks to the one-line diagram for specific equipment types. This will provide the basis for a customized safety program and work permit process compliant with 70E mandates. The level of detailed requirements for the "work task" software is necessary to ensure that any variation of equipment type, equipment layout, or work procedure can be handled and documented in the software.

    a) The software interface shall allow the user to select any breaker fuse or switch on the one-line, and get a specific work task generated for that device showing the load side arc flash hazard (let-through energy) for that device. The purpose of this requirement is to detail specific feeder hazards when work tasks dictate working downstream from a feeder protective device.
    b) The arc flash calculations shall provide integral work permits for compliance with NFPA-70E, 2004 Article 130.1 (A). The work permits shall be integral with the system one-line diagram and the arc flash calculations and shall detect and account for work between feeder and main breaker.

8. Work permits shall be activated by mouse click, for all equipment types listed in K5. Work permits shall have the following calculated values and provide the following information specific to the "work task" and equipment selected:

a) Shock hazard.
b) Shock hazard boundaries.
c) Arc flash boundary – worst-case for each equipment.
d) Arc flash hazard incident energy in cal/cm2 for the equipment.
e) Hazard Risk Category (HRC) and any applicable risk reduction.
f) Required PPE category based on calculated energy level and optional risk reduction.
g) Required PPE description based on PPE category.
h) Determination of V-rated gloves and tools.
i) Auto fill job description and procedures for each work task.
j) Auto fill safe work practices description for each work task.
k) Job briefing and planning check list.
l) Approval sign off section.
m) Working distance measurements in English or Metric units.
n) Required work distance for each task.
o) Documentation for safety program in compliance with 70E 130.1(A).

9. The work permits shall be created by the software in MS Word and have the following user customizable features:

a) Work Tasks for each specific equipment type and voltage range.
b) Restricted shock boundary.
c) Arc flash boundary – worst-case for each equipment.
d) Arc flash hazard incident energy in cal/cm2 for the equipment.
e) Hazard Risk Category (HRC) reduction for low risk tasks.
f) Required PPE category based on risk reduction.
g) Working distance in English or Metric units.
h) Working distance for each task.

i) V-rated gloves and tool requirements.
j) Flame Resistant clothing requirements.
k) Job description and procedures for each work task.
l) Safe work practices description for each work task.
m) Job briefing and planning check list.
n) Approval sign off section.

10. The power system software shall allow the created work permits to be linked via Windows “hyperlinks” to each equipment on the one-line diagram. The purpose is to provide a data repository of work permits performed on each equipment for 70E review, as well as providing a one-stop location where documents pertaining to the equipment can be accessed by maintenance and job planning.
11. The power system software shall be fully compatible with facility arc flash hazard and electrical safety implementation software that provides the following capabilities:

    a) Calculates shock hazards, shock hazard boundaries, arc flash boundaries, incident energies, PPE requirements, etc. for power systems modeled in EasyPower or EasyPower EasySolv.
    b) Built in Work Permit Feature for creation of custom Energized Work Permits complying with the NFPA-70E requirements. Work permit feature shall include NFPA risk assessment categories based on the task performed for all types of electrical equipment and voltage ranges. The work permit feature shall include an extensive library of user definable work tasks, safety procedures and safe work practices.
    c) Energized work permits, safety procedures, equipment instruction manuals, etc., shall be capable of being directly linked to the equipment one-line through a Hyperlinks feature, providing a one-stop data repository easily accessible to all plant and safety personnel, saving plant personnel and contractors significant productive time in locating the right instruction manual, equipment safety procedure, drawing, pictures and maps for the equipment. This feature shall also help interested parties with OSHA and NFPA 70E record keeping requirements.
    d) Additional equipment information and records such as Maintenance Records, Maintenance Manuals, Operations Manuals, Lock out / Tag out procedures, etc. shall also be capable of being Hyperlinked to the equipment on the graphical one-line.

e) Program shall support creation of arc flash labels with direct output to high quality UV resistant vinyl label printers.
f) Program shall also have customizable output. Includes one-line printing, text report creation, export to AutoCAD, etc.
g) Program shall be a Windows based operating system and shall use Windows conventions.
h) Program shall be capable of being installed on stand alone personal computers or on networked systems.
i) Program shall be easily operable by the OWNER's staff without any specialized training.

12. The software shall be licensed to the OWNER and the original software package will be delivered at project completion.

2.9 REPORTING AND ANALYSIS SUMMARY

A. Executive Summary: The executive summary shall be brief 1-2 pages maximum and cover at an executive level the findings of the study, recommendations, and requirements for maintaining NFPA-70E compliance.
B. Scope of studies performed: The scope shall provide details of what actions were intended to be performed for each aspect of the study, including short circuit, protective device coordination, and arc flash.
C. Description of system and explanation of bus and branch numbering system.
D. Modes of operation studied: Each scenario/plant operating condition shall be thoroughly documented.
E. Detailed report and results of short circuit, coordination, and arc flash studies including:

1. Recommendations and additions to equipment rating and/or PDC characteristics.
2. Recommendations to reduce arc flash hazards for equipment with incident energies over 40 cal/cm^2.

F. Prioritized recommendations for all studies.
G. Action list and check off column for all recommendations.

2.10 QUALITY ASSURANCE

A. The studies shall be in conformance with the NFPA and ANSI Standards, and IEEE recommended practices detailed in this section. No substitutions in study methods or software conformance will be allowed.

END OF SECTION

SECTION 26 05 09
ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 GENERAL

A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

1. Nameplates.
2. Labels.
3. Wire and cable markers.
4. Conduit markers. SECTION INCLUDES

1.2 RELATED WORK

A. Related Work specified in other Sections includes, but is not limited to:

1. Section 26 05 00 Electrical General Requirements

1.3 SUBMITTALS

A. Submit product literature including manufacturer name, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data. CONTRACTOR SUBMITTALS

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
B. Locations:

1. Each electrical distribution and control equipment enclosure.
2. Communication cabinets.
3. Each junction box.

C. Letter Size:

1. 1/8" letters for identifying individual equipment and loads.
2. 1/4" letters for identifying grouped equipment and loads.

D. Identify control device stations, motor control equipment, process equipment and instrumentation equipment. All such devices shall be labeled with equipment served, identifying name, and circuit number with panel.

2.2 WIRE MARKERS

A. Manufacturers:

1. 3M
2. Thomas & Betts
3. Panduit

B. Description: Heat shrink tubing, imprinted, type wire markers.
C. Locations: Each conductor at panel-board gutters, pull boxes, outlet and junction boxes, and each load connection, PLC panels, instrument panels, instruments, MCC's, etc.
D. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number shall be indicated on project Record Drawings.

E. Control Circuits: Control wire number shall be indicated on schematic and interconnection diagrams.
F. Data Wiring: Address number shall be indicated on each end of conductor on the face of the outlet cover, and on the space of the patch panel.
G. All conductor numbers and terminal block numbers shall be reflected on the CONTRACTOR submitted Record Drawings.

2.3 CONDUIT MARKERS

A. Manufacturers:

1. Tech Products
2. Thomas & Betts
3. Panduit

B. Description: 3/16" poly tag in poly tag holder. Tie wrapped to conduit.
C. Location: Furnish markers for each conduit longer than 6 feet.
D. Spacing: Label at each junction and terminal end.
E. Legend: Number as indicated in contractor prepared Record Drawings.

2.4 UNDERGROUND WARNING TAPE

A. Description: 4" wide detectable plastic tape, colored red with suitable warning legend describing buried electrical lines.
B. Location: Along length of each underground conduit, 12" above conduit.

2.5 LABELS

A. Self adhesive, plastic coated, machine printed.
B. Manufacturer: Brother or equal.
C. Locations:

1. Convenience outlet circuit adhered to outlet faceplate showing panel and circuit number.
2. Data address number to outlet faceplate and patch panel face plate.
3. Light switches, indicating lighting switched panel and circuit number.
4. Process wiring indicating connection point terminal block and cabinet.

PART 3 EXECUTION

3.1 PREPARATION

A. De-grease and clean surfaces to receive nameplates and labels.

3.2 INSTALLATION

A. Install nameplate and label parallel to equipment lines.
B. Secure nameplate to equipment front using screws.
C. Secure nameplate to inside surface of door on panel-board that is recessed in finished locations.
D. Identify each conduit at each end.
E. Identify underground conduits using one underground warning tape per trench at 12" above conduit.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 19
CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 GENERAL

A. Furnish and install conductors and cables as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein.

1.2 SUBMITTALS

A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work. Show proposed routing of conduits buried under floor slabs-on-grade, conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served and by conduit schedule number.

1.3 QUALITY ASSURANCE

A. MANUFACTURERS: Firms regularly engaged in manufacture of conduits and raceway systems of type and sizes required, whose products have been in satisfactory use in similar service for not less than (3) years.
B. STANDARDS: Comply with applicable portions of the NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL listed and labeled. Comply with NEC requirements as applicable to construction of raceway systems.

1.4 APPLICABLE SECTIONS

A. Section 26 05 00 Electrical General Requirements.

PART 2 PRODUCTS

2.1 COMPONENTS

A. 600 Voltage Conductors:

1. Copper with AWG sizes as shown or required:
   a. Minimum size shall be No. 12 except where specified otherwise.
   b. Conductors shall be stranded.

1) Insulation:
   a) Conductor Size No. 2 And Smaller: 600V type THWN or XHHW (75° C). All conductors run in underground conduits shall be XHHW.
   b) Conductor Size No. 1 And Larger: 600V Type XHHW-2 (90° C).
2) Colors:
   a) 120/240 V System
      (1) Black: Line 1.
      (2) Red: Line 2.
      (3) Green: Ground.
      (4) White: Neutral.
   b) 208Y / 120 V System:
      (1) Black: Phase A.
      (2) Red: Phase B.
      (3) Blue: Phase C.
      (4) Green: Ground.
      (5) White: Neutral.
   c) 480Y / 277 Volt System:
      (1) Brown: Phase A.
      (2) Orange: Phase B.
      (3) Yellow: Phase C.
      (4) Neutral: Gray.
      (5) Ground: Green.
   d) Conductors size No. 10 and smaller shall be colored full length. Tagging or other methods for coding of conductors size No. 10 and smaller not allowed.
   e) For feeder conductors larger than No. 10 at pull boxes, gutters, and panels, use taped band or color tag color-coded as specified above.

B. Instrumentation Cables:

1. Instrument cable shall be Type TC, and have the number of individually shielded twisted pairs indicated on the Drawings and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 18 AWG minimum. Shielded, grounded instrumentation cable shall be used for all analog and low voltage digital signals.
2. The jacket shall be flame retardant with 90 degrees C temperature rating. The cable shield shall be a minimum of 2.3 mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.
3. The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90 degrees C temperature rating. One conductor within each pair shall be numerically identified.
4. Pairs shall be assembled with a nominal 2 inch lay and shall then be group shielded with a minimum of 1.3 mil aluminum or copper tape overlapped to provide 100 percent coverage. All group shields shall be completely isolated from each other.

C. Control Wires:

1. Copper with AWG sizes as shown or required:
   a. Minimum size shall be No. 14 except where specified otherwise.

b. Conductors shall be stranded.
    1) Insulation:
        a) 600V type THWN or XHHW (75° C). All conductors run in underground conduits shall be XHHW.
2. Control wires may be run in same conduits as instrumentation cables.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Conductors and cables shall be continuous from source to equipment.
2. Do not use direct burial cable.
3. Instrumentation and control wires shall be run in conduits separate from power conduits.

B. 600 Voltage Conductors:

1. Install conductors in raceway except where specifically indicated otherwise. Run conductors of different voltage systems in separate conduits. All raceways shall include an equipment ground conductor.
2. Route circuits at own discretion, however, circuiting shall be as indicated or required. Group circuit homeruns to panels as shown on Drawings. No other groupings of circuits will be allowed.
3. Neutrals:
    a. On three phase, 4 wire systems: Do not use common neutral for more than one three phase circuit.
    b. On single phase, 3 wire systems: Do not use common neutral for more than one circuit per phase.
    c. Run separate neutrals for each circuit where specifically noted on Drawings.
    d. Where common neutral is run for two or three home run circuits, connect phase conductors to breakers in panel which are attached to separate phase legs so neutral conductors will carry only unbalanced current. Neutral shall be sized at 200% of full load.
4. Pulling Conductors:
    a. Do not pull conductors into conduit until raceway system is complete and enclosures, cabinets, and boxes are free of foreign matter and moisture.
    b. Install conductors in accordance with the manufacture's requirements.
    c. Use only listed non-hardening wire pulling lubricants.
5. Provide positive supports for conductors in vertical raceways at following spacing minimum, unless shorter is recommended by manufacturer.
    a. No. 18 to 1/0 — 100 feet.
    b. No. 2/0 to 4/0 — 80 feet.
    c. 250MCM to 350MCM — 60 feet.
    d. 350MCM to 500MCM — 50 feet.

C. Feeder and branch circuits shall be isolated from each other, and from instrumentation and control circuits. Instrumentation cables shall be installed in separate raceways from other cables and wiring. This includes portions running through manholes. Instrumentation cable

shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards, unless otherwise shown on the Drawings.

D. Maintain electrical continuity of the shield when splicing twisted shielded pair conductors. Drain wires shall be terminated inside enclosures at grounded terminal blocks. Only one end of each instrument loop cable drain wire shall be grounded. Ground drain wire of shielded conductors at one end only.

E. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.

1. CONTRACTOR shall supply terminal boards as required.
2. Do not field wire directly to devices.

F. Low Voltage Cables In Office Spaces (70 Volts or Less):

1. In inaccessible, concealed spaces, run cables in raceway. In accessible, unfinished areas, cables may be run exposed without raceway.
2. Run exposed cables parallel to or at right angles to building structure lines. Do not run exposed cables on floors or in such a way that they obstruct access to, operation of, or servicing of equipment. Keep cables 6 inches minimum from hot water pipes.
   a. Support cables every 3 feet with permanent clips, straps, staples, or tie wraps approved for application and which will not cause cables to be pinched or deformed.
   b. Securely attach clips and straps with nails or screws. Do not use wire or tape to support cables.
3. Bundle only cables of same systems together.

- END OF SECTION -

SECTION 26 05 22
WIRING DEVICES

PART 1 GENERAL

1.1 GENERAL

A. Furnish and install wiring devices as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein.

1.2 SUBMITTALS

A. Submit product literature including manufacturer, model or part number, materials of construction, size, ratings, and listings as a minimum.

1.3 QUALITY ASSURANCE

A. NECA - Standard of Installation.
B. NEMA WD 1 - General Requirements for Wiring Devices.
C. NEMA WD 6 - Wiring Device -Dimensional Requirements.
D. NFPA 70 - National Electrical Code.
E. UL - Underwriters Laboratories, Inc.

PART 2 PRODUCTS

2.1 WALL SWITCHES

A. Manufacturers:

1. Hubbell, Model HBL-1221, 1223, 1224 series.
2. Arrow Hart, Model 1991.

B. Description: NEMA WD 1, Heavy-Duty Specification Grade AC only general-use snap switch.
C. Body and Handle: Gray plastic with toggle handle.
D. Indicator Light: Lighted handle type switch red color handle.
E. Locator Light: Lighted handle type switch; red color handle.
F. Ratings:

1. Voltage: 120-277 volts, AC.
2. Current: 20 amperes.

2.2 RECEPTACLES

A. Manufacturers:

1. Hubbell, Model HBL 5362-SP.
2. Arrow Hart, Model 5362-CR.

B. Description: NEMA WD 1, Heavy-duty specification grade general use receptacle.
C. Device Body: Gray plastic.
D. Configuration: NEMA WD 6, type as specified and indicated.
E. Convenience Receptacle: Type 5-20.
F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

2.3 WALL PLATES

A. Decorative Cover Plate: Brushed stainless steel in electrical/control/blower rooms.
B. Process Room/Exterior Cover Plate: Gasketed cast metal with hinged gasketed device cover. Lever type switch cover. Classified hazardous as required for process areas per drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that outlet or device boxes are installed at proper height.
B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.
B. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install in accordance with NECA "Standard of Installation."
B. Install devices plumb and level.
C. Install switches with OFF position down.
D. Install receptacles with grounding pole on bottom.
E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

F. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
G. Connect wiring devices by wrapping conductor around screw terminal.
H. Use jumbo size plates for outlets installed in masonry walls.
I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Install wall switch 48 inches above finished floor.
B. Install convenience receptacle 18 inches above finished floor unless otherwise indicated.
C. Install convenience receptacle 6 inches above back-splash of counter.
D. Install dimmer 48 inches above finished floor.
E. Install telephone jack 18 inches above finished floor.
F. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches above finished floor.
G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.

3.5 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.
B. Operate each wall switch with circuit energized and verify proper operation.
C. Verify that each receptacle device is energized.
D. Test each receptacle device for proper polarity.
E. Test each GFCI receptacle device for proper operation.
F. Verify that each telephone jack is properly connected and circuit is operational.

3.6 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.7 CLEANING

A. Clean exposed surfaces to remove splatters and restore finish

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 24
EQUIPMENT WIRING

PART 1 GENERAL

1.1 GENERAL

A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
B. This section includes wiring connections to equipment specified in other sections.
C. Electrical connections to equipment: Provide the materials and make the electrical connections to all equipment having electrical requirements as indicated in the architectural and/or mechanical section of the specifications and drawings.
D. Provide conduit, wiring, connect motors and other mechanical equipment and electrical devices in other sections; also install, provide, support for, and connect starters, other control devices, control panels, furnished for such motors and equipment; complete all circuit leave in satisfactory operating conditions.
E. Provide control devices for equipment in addition to those furnished by the trades providing such equipment; refer to schedules on electrical and mechanical drawings for control devices to be furnished under scope of the electrical work.
F. Control devices and panels furnished by trades providing equipment will be delivered to electrician at site of project; acknowledge acceptance in writing; assume responsibility for particular installation before proceeding with installing and wiring them. Follow each manufacturer's printed installation directions and wiring diagrams for installing and making connections to his equipment and controls.
G. Consult contract drawings and specifications of trades providing equipment and controls, for control wiring diagrams, also refer to their shop drawings in order to become familiar with equipment type and operation of controls, their locations and extent of work required for installing, wiring and connecting them.
H. Starters for all motors requiring same shall be furnished by electrical contractor.

1.2 APPLICABLE SECTIONS

A. The General Conditions, Supplementary Conditions, Special Conditions, alternates, and addenda, applicable drawings, and the specifications including but not limited to the following:

    1. Section 01 33 00 Submittal Procedures
    2. Section 01 45 00 Quality Control and Materials Testing
    3. Section 26 05 00 Electrical General Requirements

1.3 REFERENCES

A. NEMA WD 1 - General Purpose Wiring Devices.
B. NEMA WD 6 - Wiring Devices - Dimensional Requirements.
C. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

A. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.6 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
B. Determine connection locations and requirements.
C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.1 CORDS AND CAPS

A. Manufacturers:

1. Hubbell.
2. Or equal.

B. Attachment Plug Construction: Conform to NEMA WD 1.
C. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
D. Cord Construction: NFPA 70, Type SJO multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit over-current protection.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energizing

3.2 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.
B. Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.
C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
D. Provide receptacle outlet to accommodate connection with attachment plug.
E. Provide cord and cap where field-supplied attachment plug is required.
F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
H. Install terminal block jumpers to complete equipment wiring requirements.
I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 26
GROUNDING AND BONDING

PART 1 GENERAL

1.1 GENERAL

A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

1. Grounding electrodes and conductors.
2. Equipment grounding conductors.

1.2 APPLICABLE SECTIONS

A. The General Conditions, Supplementary Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following:

1. Section 26 05 00 Electrical General Requirements.

1.3 RELATED WORK

A. Related Work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 26 05 00 Electrical General Requirements

1.4 REFERENCES

A. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
B. NFPA 70 - National Electrical Code.

1.5 GROUNDING SYSTEM DESCRIPTION

A. Metal underground water pipe.
B. Metal frame of the building.
C. Concrete-encased electrode.
D. Rod electrode.
E. Plate electrode.
F. Active electrode.

1.6 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms maximum.

1.7 SUBMITTALS FOR REVIEW

A. Product Data: Provide for grounding and bonding equipment.
B. All submittals shall include a list of all items being submitted by description, manufacturer and catalog number.

1.8 SUBMITTALS FOR CLOSEOUT

A. Section 26 05 05 - Operation and Maintenance Manuals.
B. Project Record Documents: Record actual locations of components and grounding electrodes.
C. Certificate of Compliance: Indicate approval of installation by the authority having jurisdiction.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

1.10 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.
B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

A. Material: Copper Clad Steel.
B. Diameter: 5/8 inch.
C. Length: 10 feet (3000 mm).

2.2 CONNECTORS

A. Manufacturers:

1. T&B
2. Burndy - Hi-Ground
3. ERICO® - Cadweld®

B. Material: Irreversible Crimp Style or Exothermic Weld.

2.3 WIRE

A. Material: Stranded copper, tinned.

B. Grounding Electrode Conductor: Size as indicated in the Drawings, or if modified or not indicated, size to meet NFPA 70 requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

A. Install electrodes at locations indicated and in accordance with manufacturer's instructions. Install additional rod electrodes as required to achieve specified resistance to ground.
B. Provide grounding electrode conductor (UFER) and connect to reinforcing steel in foundation footing. Bond steel together.
C. Provide bonding to meet Regulatory Requirements.

3.3 FIELD QUALITY CONTROL

A. Perform inspections and tests listed in NFPA ATS, Section 7.13.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 30
CONDUIT

PART 1 GENERAL

1.1 GENERAL

A. Furnish and install conduits and raceway systems as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein.

1.2 SUBMITTALS

A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work. Show proposed routing of conduits buried under floor slabs-on-grade, conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served and by conduit schedule number.
C. Proposed location and details of construction for openings in slabs and walls for conduit runs.

1.3 QUALITY ASSURANCE

A. MANUFACTURERS: Firms regularly engaged in manufacture of conduits and raceway systems of type and sizes required, whose products have been in satisfactory use in similar service for not less than (3) years.
B. STANDARDS: Comply with applicable portions of the NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL listed and labeled. Comply with NEC requirements as applicable to construction of raceway systems.

1.4 PROJECT/SITE CONDITIONS

A. GENERAL

1. Unless otherwise specified, equipment and materials shall be sized and derated for ambient site conditions, but in no case less than an ambient temperature of 40 degrees C at an elevation ranging from seal level to 4,300 feet without exceeding the manufacturer's stated tolerances.

B. AREA CLASSIFICATIONS

1. For the purpose of delineating the basic electrical construction materials and installation requirements for this project, areas of the project have been classified on the contract drawings as defined below. Electrical work within these areas shall conform to the requirements described below as well as the referenced code requirements.

a. General Purpose (NEMA 1): Areas requiring general purpose (NEMA 1) construction are indoor areas typically architecturally finished, always dry, and occupied by plant personnel.
b. Corrosive Process Areas (NEMA 4X): Areas requiring corrosion resistant (NEMA 4X) construction. Corrosive process areas typically contain pumping or piping systems and are subject to spills and washdown. Corrosive process areas shall also include those areas containing corrosive chemicals.
c. Outdoor Areas (NEMA 3R): Areas outdoors require weather resistant (NEMA 3R) rating.
d. Hazardous Areas (NEMA 7): Unless otherwise indicated on the contract drawings, areas requiring hazardous location (NEMA 7) construction are classified as Class 1, Division 2 or Class1, Division 1 hazardous locations per Articles 500 and 501 of the National Electrical Code. See classification drawings.
e. Process Areas (NEMA 12): Areas requiring drip-proof (NEMA 12) construction are indoor process and support system areas and are not typically subject to spills, direct washdown, or corrosive chemicals under normal operating conditions, but may experience occasional or unintended wetness.

1.5 CONSTRUCTION MATERIALS:

A. Construction materials required for each area classification are listed in table A below. Refer to the individual specification section for each component for material composition and installation practices.

	Area Classification				
Component	NEMA 1	NEMA 3R[1] Outdoor	NEMA 4X[1] Indoor Corrosive	NEMA 12[1]	NEMA 7 Classified Explosion Proof/Process Area
Conduit (exposed)	GRS	RA PGRS	RA PGRS	RA PGRS	PGRS
Conduit (concealed)[4]	EMT[3]	PGRS GRS	RA	GRS	GRS
Flexible conduit[5]	LFS	LFS	LFN	LFN	Classified
Support systems	Galvanized Steel	Aluminum	Stainless steel	Aluminum	Stainless steel
Fastening hardware and hanger rods	Cadmium plated steel	Stainless steel	Stainless steel	Cadmium plated steel	Stainless steel
Control Stations[2,6]	Painted Steel	Non-Metallic	Non-Metallic	Painted Steel	Classified

Enclosures[2,6]	Painted Steel	Non-Metallic	Non-Metallic	Painted Steel	Classified
Receptacles[2] Surface Recessed	General General	WP[8] WP[8]	WP[8] N/A	WP[8] WP[8]	Classified N/A
Switches[2] Surface Recessed	General General	WP[8] WP[8]	WP[8] N/A	WP[8] WP[8]	Classified N/A

Notes:

1. Enclosures, device boxes, control stations and raceway systems shall be mounted with ¼-inch (minimum) space between the electrical system and supporting structure.
2. Conduit terminations to control stations, enclosures, and device boxes in NEMA 3R, 4X, 7 and 12 areas shall be made through threaded hubs.
3. Rigid conduit concealed in framed walls, block walls and ceiling spaces shall be electrical metallic tubing, type EMT.
4. Conduit ductbank or beneath slab on grade shall be rigid PVC-40 conduit, without pullboxes, and with waterproof conduit splices beneath grade to limit water penetration.
5. Flexible conduit shall be utilized for final connections to equipment.
6. Control station and enclosure sealing ratings shall meet or exceed the rating designated by the area classification.
7. Exposed conduit systems in areas containing equipment handling Ferric Chloride shall be PGRS.
8. Use gasketed lever type switches and up-in use red dot steel receptacle covers.

Legend:

EMT Electrical Metallic Tubing
GRS Galvanized Rigid Steel
LFS Liquid Tight Flexible Steel
LFN Liquid Tight Flexible Non-Metallic
PGRS PVC Coated Galvanized Rigid Steel
PVC4 PVC Schedule 40
PVC8 PVC Schedule 80
RA Rigid Aluminum
WP Weatherproof – Use cast device boxes with threaded hubs
XP Explosion proof – Approved conduit systems per classification listing
N/A Non applicable

PART 2 PRODUCTS

2.1 CONDUIT AND TUBING

A. GENERAL

1. Provide conduit and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".

B. Electrical Metallic Tubing (EMT)

1. Per UL "Standard for Electrical Metallic Tubing" No. 797. Galvanized mild steel with interior coat of enamel.
2. Fitting shall be steel, compression type. Cast type or indenter type fittings are not acceptable.
3. Approved for concealed interior locations of the Electrical Room.

C. Galvanized Rigid Metal Conduit (GRC): FS WW-C-0581 and ANSI C80.1

1. Per USAS C80.1, zinc-coated by hot-dip galvanizing or sherardizing with additional enamel or lacquer coating.
2. Couplings shall be threaded type of same material and finish as conduit. Connectors shall be Myers hubs or equal of same material and finish as conduit.
3. Approved Locations: Interior where exposed, where not exposed to moisture or corrosive atmosphere.

D. High Density Polyethylene Plastic Pipe (HDPE), Or Polyvinyl Chloride (PVC) Schedule 40, Based on Outside Diameter:

1. Conduit suitable for direct burial. 1” minimum size.
2. Fittings shall be threaded, glued, or heat welded type of same material as conduit. No splices are allowed underground in locations with high water table.
3. Approved for underground direct burial, May be used where buried in earth under floor slabs.
4. Minimum depth of bury under slab shall be 18 inches or of sufficient depth to allow for bending radius to rise out of the slab vertically. Shall have an exposed grounding electrode conductor in each trench.
5. Not approved for above grade installation nor for embedding in concrete slabs.
6. Exterior underground conduits, all elbows shall be PVC coated GRS or Fiberglass.
7. All buried conduit between VFDs and motors.

E. PVC Coated Galvanized Rigid Metal Conduit (PGRC): NEMA RN 1

1. Rigid galvanized conduit, prior to plastic coating, shall conform to ANSI Standard C80.1, UL 6, and CSA Standard C22.2 #45.
2. Nominal thickness of exterior PVC coating shall be 40 mils. A two-part red urethane coating of 2 mil thickness shall be applied to the interior of all conduits and fittings.
3. All hollow conduit fittings which serve as part of the raceway system shall be coated with exterior PVC coating and red interior urethane coating as described above.
4. Coated conduit shall conform to NEMA Standard No. RN1-1989. Shall be "Plastic-Bond Red" as manufactured by Robroy Industries, Inc.
5. Approved Locations: Shall be used in all locations where conduits are buried, in contact with earth, and in wet and corrosive areas, and as noted on the drawings. All risers through concrete floors, all embedded conduit, and all elbows of ductbanks underground.

F. Liquidtight Flexible Metal Conduit: UL 360

1. Galvanized steel with an extruded liquidtight PVC cover that is moisture and oil-proof, and UV resistant.
2. Fittings shall be liquidtight compression type, listed for grounding. Provide fittings with external bonding jumper where required for bonding.
3. Approved for flexible connections to equipment subject to vibration such as motors, fan, pumps, dry transformers, etc., 36-inch maximum, 18" minimum length for each connection.

G. Flexible Metal Conduit: UL 1

1. Galvanized steel.
2. Approved for flexible connections to equipment in unclassified areas of the Administration Building.

H. Ridged Aluminum Conduit

1. Couplings shall be threaded type of same material and finish as conduit. Connectors shall be Myers hubs or equal of same material and finish as conduit. Approved Locations: Interior where exposed, on the exterior exposed to moisture or corrosive atmosphere. Approved for above grade installation. May be used within the process area of the plant.

I. Conduit Bodies:

1. Form 7 malleable iron with hot dip galvanized finish, PVC coated in wet or process areas of plant.
2. Gasketed cast iron, zinc plated cover with stainless steel screws.

PART 3 EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS

A. General Requirements: Unless otherwise indicated, wiring shall consist of insulated conductors installed in conduits or raceways.

3.2 CONDUIT AND TUBING SYSTEMS

A. Conduit and tubing systems shall be installed as indicated. Conduit sizes are based on the use of insulated, copper conductors. Minimum size of raceways shall be as noted. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. PVC coated rigid metal conduit will be used in damp, wet or corrosive locations and the conduit or tubing system will be provided with the appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Any exposed threads or metal shall be touched up with 3 coats of touch up material provided with conduit. Raceways shall be kept 6" away from parallel runs of any mechanical piping. Raceways shall be concealed where possible. Raceways crossing structural expansion joints shall be provided with suitable expansion fittings and will provide continuity for grounding.

3.3 BELOW SLAB-ON-GRADE OR IN THE GROUND

A. All electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing through slabs-on-grade shall be PVC coated rigid metal conduit. PVC conduits shall be installed

below slab-on-grade or in the earth. All underground bends over 22º and risers through concrete slab shall be PVC coated GRC.

3.4 INSTALLED IN SLABS INCLUDING SLABS ON GRADE

A. Conduit shall not be embedded in concrete slabs except as specifically detailed.

3.5 EXPOSED RACEWAYS

A. Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above ceilings shall be considered as exposed installations.

3.6 CHANGES IN DIRECTION OF RUNS

A. Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field made bends and offsets shall be made with an approved hickey or conduit bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp or wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed from obstructions or shall be replaced.

3.7 SUPPORTS

A. Metallic conduits and tubing shall be securely and rigidly fastened in place at intervals of not more than 10' and within 3' of boxes, cabinets, enclosures, and fittings, with U-channel support systems, one hole conduit straps with clamp backs, and conduit hangers. All supports mounted in exterior, process, or exposed areas subject to corrosive atmosphere shall be stainless steel. Supports in other areas shall be hot dipped galvanized. C-clamps or beam clamps shall have strap or rod type retainers. Rigid plastic conduits (if permitted as wiring method) shall be supported as indicated above, except that they shall be supported at 3’-0” maximum on centers and as indicated in the NEC (NFPA 70). Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging.

B. Fastenings shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a power charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or supports shall not be welded to steel structures. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4" in concrete joints shall avoid cutting the main reinforcement bars. Holes not used shall be filled. In partitions of light steel construction, sheet metal screws shall be used. Conduits shall not be supported using wire or nylon ties.

C. Raceways shall be installed as a complete system and shall be independently supported from the structure. Upper raceways shall not be supported of lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports.

D. Support Installations:

1. U-channel supports generally are not detailed but must be adequate to support combined weights of conduit and conductors.
2. Clamps: Galvanized malleable iron one-hole straps with clamp backs, beam clamps or other approved device with necessary bolts, expansion shields. Perforated metal straps shall not be used.
3. Adjustable U-channel Supports: Used to support horizontal runs only, use trapeze hangers for parallel runs of conducts.
4. Surface mounted raceway bases shall be anchored to ceiling members or block walls on 5'-0" centers maximum spacing and at all junction and device boxes and at angle fittings. Anchors shall be: Expansion shields on concrete or solid masonry, toggle bolts on hollow masonry units or on suspended ceilings.

3.8 INSTALLATION OF RACEWAYS AND FITTINGS:

A. General

1. All Conduit: In accordance with requirement of National Electrical Code and applicable local codes.
2. Steel Conduit: In accordance with recommendations of American Iron and Steel Institute "Design Manual on Steel Electrical Raceways," latest edition.

B. Electrical Continuity

1. All metallic conduit systems shall be electrically continuous throughout.

C. Moisture

1. All conduit systems shall be essentially moisture tight.

D. Alignment of Exposed Conduit

1. Parallel with or at right angles to lines of structure.

E. Field Cuts and Threads

1. Cuts shall be square, threads clean and sharp. Remove sharp or rough edges by reaming burrs. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of rigid steel conduit. Apply coat of red lead, zinc chromate or special compound recommended by manufacturer of conduit where conduit protective coating is damaged.

F. Bends

1. Uniform, whether job-fabricated or made with standard fittings or boxes. Do not dent or flatten conduit.
2. Exposed Conduit: Symmetrical insofar as practicable.

G. Location

1. Routing: Generally shown in schematic fashion, unless dimensioned or noted to contrary. Contractor shall determine actual routing as approved.
2. Conduit Not Shown: Contractor shall route as required to connect equipment as specified.
3. Vertical Risers, Equipment and Device Locations: Approximately as shown. Contractor shall coordinate installation of conduit, in locations indicated, with structure and equipment.
4. Conduit in Relation to Steam or Hot Water Lines or Other Hot Surfaces: Locate minimum of 6" away. If such separation is impracticable, protect from heat as approved.

H. Buried Conduit

1. Depth of Burial: Minimum of 24" below finished grade with warning tape 12" above conduit.

I. Wall Penetrations: Required for passage of conduits installed by CONTRACTOR through walls, or partitions.

1. Penetrations Through Exterior Building Walls: Cast in sleeve/Core drill wall and provided conduit entrance seals as detailed. All penetrations shall be with rigid steel conduit PVC coated within the plant process areas.
2. Openings Required Through Existing Partitions: Shall be provided at CONTRACTOR's expense. Holes through masonry construction shall be cast/ drilled with suitable coring machine. Perform work neatly. Patches shall match original material in composition and appearance.
3. Provide fire seals where a fire rated partition or wall is penetrated.

J. Expansion Fittings

1. Install in all conduit runs crossing structural expansion joint or in straight runs 75 feet or more in length.

K. Conduit Ends

1. Cap spare conduits.
2. Open Conduit Ends Terminating in Switchboards, Cabinets or Similar Locations Where Exposed to Entrance of Foreign Material: Install insulating grounding bushing. Plug space around cables with sealing compound.
3. Cap or plug conduit ends to prevent entrance of foreign material during construction.

L. Conduit Connections

1. Cabinets, Enclosures, and Boxes: Double lock nuts and insulating bushings for rigid conduits in unclassified areas, NEMA 1. Hubs for rigid conduits in damp, wet, exterior, or corrosive areas, NEMA 12, 3R, 4, 4X. Bushings, insulating type, bell ends, or insulated throat fittings shall be installed on the ends of all conduits. Grounding type fittings and bushings shall be utilized as required for bonding.
2. Metallic Conduit Terminating in Non-Metallic Manholes or Pull Boxes: Insulated grounding bushing with lay-in ground lugs.
3. Flexible conduit for connection to movable equipment shall be liquidtight, utilizing listed liquidtight fittings.

M. Cleaning

1. Clean and swab inside of conduits by mechanical means to remove foreign materials and moisture before conductors are installed.

N. Spare Conduits

1. Install nylon pull line for future installation of cables. Cap all conduits and mark where end is located on Record Drawings with dimensions.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 05 32
CONDUIT DUCTBANKS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install conduit ductbanks as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein. All exterior conduit shall be buried underground and embedded in sand as detailed.

1.2 SUBMITTALS

A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work. Show proposed routing of conduits buried under floor slabs-on-grade, conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served and by conduit schedule number.

1.3 QUALITY ASSURANCE

A. MATERIAL MANUFACTURERS: Firms regularly engaged in manufacture of duct system components of type and sizes required, whose products have been in satisfactory use in similar service for not less than (3) years.
B. STANDARDS: Comply with applicable portions of the NEMA standards pertaining to underground ducts. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL listed and labeled. Comply with NEC requirements as applicable to construction of raceway systems.

1.4 APPLICABLE SECTIONS

A. Section 31 22 00 - Earthworks
B. Section 26 05 00 - Electrical General Requirements.
C. Section 26 05 19 – Conductors and Cables.

PART 2 - PRODUCTS

2.1 DUCTS

A. Ducts shall be round-bore, size as indicated, Nonmetallic Conduit, PVC-40.
B. Duct elbows, bends, and off-sets shall be per the manufacturer’s requirements. Metal or PVC conduits underground are not allowed.

PART 3 - EXECUTION

3.1 CONDUIT BANKS

A. Each ductbank shall be completely encased in sand. Thickness of sand over, under and around ductbank shall be not less than 3 inches as detailed. All ductbanks shall include a grounding electrode conductor as detailed.
B. Unless noted otherwise, the top of the concrete envelope shall be not less than 2'-6" below finished grade or paving.
C. Ducts shall be installed to provide a water-tight, continuous length duct. If required, joints in duct shall be as per the manufacturer's requirements, and staggered at least 6 inches.
D. Saddles shall be used for support as indicated on the drawings. Hold down anchors shall be provided as indicated and required to prevent duct from floating on wet concrete.
E. During construction, ends of ducts shall be plugged to prevent debris from entering into ducts. Particular care shall be taken to keep ducts clean of concrete or any other substance during the course of construction.
F. After each duct line has been completed, a mandrel not less than 12 inches long, having a cross section approximately 1/2" less than the inside cross section of the duct, shall be pulled through to clean out the duct of earth, sand or gravel.
G. Trenching, backfilling and surface repair shall be done in accordance with Division 2 of these specifications. Hand dug or vacuum truck dug trenches are required where risk of contact with other underground utilities are present.
H. Ductbanks shall be straight without bends or off-sets if at all possible.
I. Over each ductbank at approximately 12 inches below grade, provide a detectable continuous red plastic warning tape to alert future excavators of the presence of the ductbank.
J. Provide nylon pull line in all ducts.

- END OF SECTION -

SECTION 26 05 34
ELECTRICAL BOXES AND FITTINGS

PART 1 GENERAL

1.1 GENERAL

A. Furnish and install electrical boxes and electrical fittings as required, and as shown on the Drawings. Materials employed shall be as indicated on the specified herein.

1. Types of electrical boxes and fittings in this section include the following:
2. Outlet boxes
3. Junction boxes
4. Pull boxes
5. Conduit bodies
6. Bushings
7. Locknuts and hubs
8. Knockout closures
9. Miscellaneous boxes and fittings.

1.2 SUBMITTALS

A. Submit product literature including manufacturer, model or part number, materials of construction, size, ratings, and listings as a minimum.

1.3 QUALITY ASSURANCE

A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings.
B. Comply with ANSI C 134.1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxed, covers and box supports. Provide electrical boxes and fittings, which have been UL listed and labeled.

PART 2 PRODUCTS

2.1 FABRICATED MATERIALS

A. Flush Interior Outlet or Device Boxes: Provide one piece, galvanized flat rolled sheet steel interior wiring boxes of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices; minimum depth 1-1/2". Provide minimum 2-1/8" depth for boxes with three or more conduit entries.
B. Interior Outlet or Device Box Accessories: Provide box accessories as required for each installation, including mounting brackets, hangers, extension or plaster rings, fixture studs, cable clamps and metal straps for supporting boxes, which are compatible with boxes being used and fulfilling requirements of individual wiring applications.

C. Exposed Outlet or Device Boxes: Provide corrosion- resistant cast-metal type FD weatherproof wiring boxes of types, shapes and sizes (including depth) required, with integral threaded conduit hubs, face plates with spring-hinged waterproof caps suitable configured for each application, with face plate gaskets and corrosion-resistant fasteners.
D. Junction and Pull Boxes: Provide junction and pull boxes with covers of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless hardware. Provide underground concrete junction boxes as required or indicated on the Drawings. Provide cast steel boxes with threaded hubs and gasketed cover as required or indicated on the Drawings.
E. Conduit Bodies: Provide galvanized cast-metal Form 7 conduit bodies of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.
F. Bushings, Knockout Closures, Locknuts, and Hubs: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and hubs, and conduit bushings and offset connectors of types, and sizes to suit respective uses and installation.
G. All boxes, fittings, and conduit bodies shall be PVC coated wherever PVC coated conduits are required elsewhere in this specification.

PART 3 EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
B. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
C. Provide cover plates for all boxes. See Section 26 05 22, Wiring Devices.
D. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.
E. Provide knockout closures to cap unused knockout holes where blanks have been removed.
F. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Install recessed boxes with face of box or ring flush with adjacent surface.
G. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them.
H. Provide electrical connections for installed boxes.

- END OF SECTION -

SECTION 26 05 74
ELECTRICAL MOTORS

PART 1 - GENERAL

1.1 SCOPE

A. This section specifies alternating current induction motors 300 horsepower and less to be provided with the driven equipment. This section refers to motors by the enclosure type as defined in NEMA MG 1. Compliance by the supplier to the requirement of the specification does not relieve them of responsibility of furnishing motors and motor accessories that are suitable for the specified service conditions.

1.2 QUALITY ASSURANCE

A. General

1. Motors shall be built in accordance with UL 1004, NEMA Standard MG 1, and to the requirements specified herein.

B. References

1. This section references the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
FORM A-1 1	Motor Data Sheet
IEEE 85	Test Procedure for Airborne Sound Measurements on Rotating Machinery
NEMA ICS 6	Enclosure for Industrial Controls and Systems
NEMA MG 1	Motors and Generators
UL 1004	Motors, Electric
NEC	National Electric Code, Latest Edition

1.3 SUBMITTAL DATA

A. Complete motor data shall be submitted with the driven machinery submittals. Motor data shall include.

1. Machine tag and loop number, as identified in the P&IDs, and specifications number of driven machine.
2. Motor manufacturer.
3. Motor Type or model and dimension drawing.
4. Nominal horsepower at installed altitude.

5. Nominal efficiency.
6. NEMA design.
7. Frame size.
8. Enclosure.
9. Winding insulation class and treatment.
10. Rated ambient temperature.
11. Service factor.
12. Voltage, phase, and frequency rating.
13. Full load current at rated horsepower for application voltage.
14. Starting code letter, or locked rotor KVA, or current.
15. Special winding configuration such as part winding, star-delta.
16. Rated full load speed.
17. Power factor at full load.
18. Power and connection requirements of motor winding heaters.
19. Temperature protective devise ratings and connection information.
20. Recommended maximum size power factor correction capacitor.
21. Motor insulation dielectric withstand rating.
22. If driven from a variable frequency drive:

    a. Certification that the motor meets the requirements of NEMA MG-1 1993 part 31.
    b. Certification that the motor and mechanical drive are matched in design and suitable for use together for the specific installation and driven equipment conditions.

B. The OWNER/CONTRACTOR shall complete the motor data sheet at the end of this Section for each and every motor supplied, and submit the completed forms to the ENGINEER for review, as part of the submittal package for each piece of equipment.

C. Motor insulation resistance test report.

1.4 SERVICE CONDITIONS

A. Environmental Conditions

1. All motors are subject to hose directed spray and up to a temperature 40°C. Motors shall be totally enclosed unless otherwise specified and shall be rated for service at elevation 5,000 feet above mean sea level. Motors shall meet the criteria as specified in NEMA MG 1 for usual environmental conditions.

B. Operating Conditions

1. Motors shall be selected for the operating conditions of the driven equipment in accordance with NEMA MG 1. Motors shall be subject to the vibration performance limits as follows:

a. The rotor shall be dynamically balanced according to NEMA Standards. Balance limits shall be 1/2 the limits shown on NEMA MG 1-12.06. The depositing of metal on the rotor (solder, weld, etc.) to achieve balance is not acceptable. Pavement metal is to be removed to achieve a balance only without effecting the structural strength of the rotor. Chiseling or sawing parent metal is prohibited. The addition of weights is acceptable.

1.5 PERFORMANCE REQUIREMENTS

A. Motors shall be continuous duty of the type generally described as having normal starting torque with low current, NEMA design “B”.

B. Starting current for fully loaded motors shall be as defined by NEMA design “B”.

C. Motors shall be sized for operation at their respective horsepower rating, never at their service factor rating. All motors shall be rated with a service factor of at least 1.15.

D. The motor must develop sufficient locked rotor torque to provide breakaway of the load and to provide adequate torque during the acceleration period to overcome the load and inertial forces.

E. Acceleration time must be short enough to be within the thermal limits of the motor, but not so short that it over stresses the driven equipment.

F. Overhung load requirements such as the number and pitch radius of the motor-shaft-mounted pulley sprocket, etc., and the distance from the motor front bearing to the center of the pulley, sprocket, etc. must be determined and included in the purchase order.

G. Motors are to be manufactured with multiple dips of Class H varnish in order to accommodate the application of adjustable speed drive systems voltage and severe duty environments.

H. All equipment manufacturers shall provide a totally enclosed fan cooled motor, corrosion resistant and rated for severe, continuous duty operation.

I. Motors shall operate successfully at rated load under the various combinations of voltage and frequency variations specified in section 12.44 of NEMA MG1-1998.

J. Motors shall operate successfully under running conditions at rated load and frequency when the voltage unbalance at the motors terminals does not exceed 1%.

K. Motor balance and vibration shall meet NEMA standards as defined in MG1-1998 part 7. The motor shall be dynamically balanced to meet 0.08 in/s maximum velocity at the bearing housing when measured in the horizontal, vertical and axial plane (0.12 in/s on 2-pole motors frame 280 and above).

L. Unless otherwise specified in the equipment description, the motor rotation shall be possible in either direction – application permitting. See motor data sheet.

1.6 MOTOR CONSTRUCTION

A. Mechanical and Electrical Features:

1. All motors ¼ Hp through 2 Hp may have either NEMA C-Face or floor mounted feet, or both. Motors above 2 Hp shall be foot mounted in preference to any other method. Mounting requirements are provided in the horsepower descriptive section of the documents.
2. All motors controlled by a variable speed drives shall be equipped with motor shaft ground rings.
3. Long shaft motors are preferred over short shaft for close-coupled applications. Shafts shall have Impro seal supplied on both bearings. Motor shaft diameter shall comply with NEMA standard size for the motor frame size specified. Reduced, custom, or special shaft diameter motors are not acceptable unless specifically required by the application and approved, in writing, by project engineer. Notification of such variance must be submitted with bid proposals.
4. Motor speeds are dictated in the equipment descriptive documents included with this specification.
5. The following NEMA frame size shall be provided unless specifically approved by the project engineer (3600, 1800, 1200 & 900 RPM):

    a. 1 Hp through 2 Hp on a 143 T(C) to 213 T (C).
    b. 3 Hp through 5 Hp on a 182 T(C) to 254 T (C).
    c. 7.5 Hp through 10 Hp on a 213 T(C) to 284 TS
    d. 15 Hp through 25 Hp on 254 T to 326TS

e. 30 Hp through 50 Hp on 286T to 404T
f. 60 Hp through 100 Hp on a 364 T to 445T
g. 125 Hp through 300 Hp on a 445TS to 5010 US
h. Above 200 Hp, frame selection shall be defined on equipment data and motor data sheets.

6. Stator frame, end brackets, fan cover and conduit box shall be manufactured of high 25 grade cast iron. All frames shall be designed and constructed such that on direct-coupled applications the motor can be mounted and aligned without distortion of the feet, and sufficient strength to withstand overhung loads for belt drive applications. The motor shall be designed with the capabilities for mounting the drive side vertically up or down as required by the application.
7. Ventilating fans shall be non-sparking bronze alloy or non-conductive nylon 66 materials. The ventilation shall be such that cool air is drawn in and hot air expelled to avoid mixing with the incoming air.
8. All motors 1 Hp to 250 Hp shall be rated and wired as 3 phase, 60 Hertz 460 volt operation. Exceptions to this requirement must be reviewed and authorized by the project engineer. If wired for 230/460 volt, a wiring diagram shall be illustrated on the inside of the conduit box or name plate.
9. Moisture inhibiting coating shall protect the rotor and stator. These coatings must match or exceed the anticipated full load thermal conditions, vibration, and shock electrical insulation ratings of the motor.
10. All cast iron motor parts shall be primed and painted with epoxy or polyester resin enamel or similar coatings for additional corrosion and moisture protection.
11. Motor stator and rotor steel shall be low-loss C-5 electrical grade silicon steel with interlamination insulation capable of withstanding a minimum of 1000 ^{o}F burnout. Stator random windings shall be copper and shall be insulated with class H insulation.
12. Bearings shall be either 300 series ball bearings or cylindrical roller bearings on the drive end and opposite drive end. Bearings shall be selected to provide a minimum L-10 life of 50,000 hours with an external load per NEMA MG 1-14 and a L-10 life of 100,000 hours in direct coupled applications. Bearing type shall be defined on the motor data sheet.
13. Bearings shall have a maximum of 45^{o}C rise at rated horsepower (50 ^{o}C for 2-pole motors).

14. Bearings on frames 143T through 5010UZ shall be regreaseable with regreasing instructions labeled on the motors. The bearings found in frames 213T and larger shall have open bearings with cast iron inner bearing caps. If motor is to be operated by a variable frequency drive the manufacturer shall provide optional insulated bearings on both end of direct coupled motors. See motor data sheets for VFD motors.
15. The motor bearing housing shall have an extended automatic grease relief valve to effectively prevent bearings from being over-lubricated.
16. The motor nameplate shall have raised letters stamped on 304 stainless steel and be fastened to the motor frame with four stainless steel drive pins.
17. All motor hardware shall be English type and grade 5 zinc-dichromate plated.
18. The winding insulation system shall be Class H or better, non-hygroscopic, chemical, corrosion, fungus and humidity resistant. The complete insulation system will have a minimum resistance of 1.5 megohms after 168 hours of testing in a humidity chamber maintained at 100% relative humidity and 40º C ambient with both end bells removed. Motors used in adjustable speed drive applications shall have an insulation rating of 1860 vac peak with a 0.1 micro second rise time.
19. Motor leads shall be stranded copper, permanently identified on both ends and are brought out into the motor terminal box through a neoprene lead-positioning gasket with compression type terminal lugs. Each of the three leads shall be brought through a single hole into the conduit and termination box.
20. The conduit box shall be cast iron and threaded for rigid conduit connection. Conduit box shall be located at the F1 position of the motor unless otherwise noted on the motor data sheet. Conduit box volumes shall exceed the NEMA minimum standards by a minimum of 25% and boxes shall be able to rotate 90-degree increments. A bronze ground lug shall be provided in the conduit box.
21. A lifting eyebolt shall be provided for motor lifting (180 frame and larger). Eyebolt holes shall be threaded blind holes.
22. Motors shall be suitable for field configuration to any ceiling, wall, or floor mounting by rotating conduit box, end shield, and rotor – per application requirements (143T through 365T).
23. All motors shall meet the “NEMA Premium” efficiency requirements as outline by NEMA Table 12.12. Any deviation from this specification shall be received in writing from the project engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. General Electric Company.
2. Louis Allis (Division of MagneTek, Inc.)
3. U.S. Motors Corporation
4. Toshiba.
5. Reliance.
6. Baldor Gold Series.
7. Or prior-approved equal.

B. The OWNER/CONTRACTOR shall assign to the designated equipment supplier the responsibility to select and supply suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review and acceptance by the ENGINEER. Such review will consider future availability of replacement parts and compatibility with driven equipment.

2.2 MOTORS LESS THAN ½ HORSEPOWER:

A. General

1. Unless otherwise specified, motors less than 1/2 horsepower shall be squirrel cage, single phase, and capacitor start induction run. Small fan motors may be split-phase or shaded pole type. Wound rotor or commentator type single phase motors are acceptable where its characteristics are necessary for the application. Conductors shall be copper.

B. Rating

1. Motors shall be rated for operation at 115 volts, single phase, 60 Hz, and shall be continuous-time rated in conformance with NEMA Standard MG 1-10.35. Dual voltage rated motors are acceptable if all leads are brought out to the conduit box.
2. Locked rotor current shall not be greater than specified in NEMA Standard MG1-10.36, Design “N”.

C. Enclosures

1. Unless otherwise specified, motors shall be totally enclosed.

D. Bearings

1. Motors shall be provided with sleeve-type or sealed ball bearings lubricated for 5 years normal use.

E. Insulation

1. Comply with NEMA 1-1.65.
2. Motors shall be furnished with Class F insulation, rated to operate at a maximum ambient temperature of 40ºC and at the altitude where the motors will be installed and operated, without exceeding temperature rise limits stated in NEMA MG 1-12.42 for a Class B insulation at ambient temperature of 40°C, and without using the service factor.

2.3 MOTORS 1/2 HORSEPOWER THROUGH 300 HORSEPOWER:

A. General

1. The nominal motor horsepower shall be adequate for the driven machine without infringement upon the motor service factor at the installed altitude and specified ambient conditions.
2. The motor horsepower shall be not more than the estimated maximum specified for each driven machine.

    a. If the estimated maximum horsepower specified is not adequate to satisfy the foregoing restriction or any other requirements of these specifications, the motor with the next larger horsepower shall be supplied at no additional cost to the OWNER.
    b. In addition, any changes caused by increase in motor horsepower shall be made by the OWNER/CONTRACTOR at no additional cost to the OWNER; such changes may involve circuit breakers, motor controllers, VFDs, motor and branch circuit and feeder conductors and conduit sizes, etc.

3. Some requirements of the Section may be excluded for motors which are part of valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment (i.e., non-NEMA mounting, common shaft with driven element), to the extent that such variation reflects a necessary condition of motor service or a requirement of the specified driven equipment.
4. Motor Voltage Ratings: The OWNER/CONTRACTOR is required to review the Electrical Drawings and Specifications and to furnish all motors with voltage and phase as shown on the electrical drawings.

a. The OWNER/CONTRACTOR shall notify the ENGINEER of any discrepancy between any motor sizes indicated by the Drawings and specified elsewhere, and any requirements of the driven equipment and the availability of motors from the manufacturers listed above.

5. Special Requirements: The OWNER/CONTRACTOR shall refer to individual equipment specifications and the Drawings for special requirements such as motor part winding start, multi-speed windings, protective devices, auxiliary devices, etc.
6. Horizontal Motors Installed Outdoors: All horizontal motors which will be installed outdoors shall be totally enclosed, fan cooled (TEFC) severe duty and/or chemical duty rated with a Service Factor of 1.15 unless otherwise noted or if the area classification required a more stringent motor enclosure.
7. Horizontal Motors Installed Indoors: Unless otherwise specified, all horizontal motors which will be installed indoors shall be TEFC (totally enclosed fan cooled) with a service factor of 1.15 minimum.

    a. All motors larger than 1 HP, located in damp environment such as in pump and pipe galleries, tunnels, chemical feed and sludge areas, shall be severe duty and/or chemical duty rated complying with IEEE 45.

8. High Efficiency Motors: Motors with a nameplate rating of 5 HP and above shall be "premium efficiency" units. Criteria stated herein, apply to horizontal motors without exception and apply to vertical motors insofar as they are available at time of construction.

    a. Efficiency shall be determined by the test as set forth in IEEE 112, Method B.
    b. If the inrush current due to the high efficiency design of the motor exceeds the available settings of the motor circuit protector, the motor circuit protector may be changed to a thermal magnetic circuit breaker, with the permission of the ENGINEER, at no additional cost to the OWNER.

        1) If is the OWNER/CONTRACTOR'S responsibility to perform the motor starting requirement coordination, and to notify the ENGINEER of any discrepancies.

B. Three Phase Motors

1. All motors 1/2 HP and larger shall be three phases unless otherwise indicated on Drawings, or specified elsewhere.
2. Voltage: All three phase motors shall be suitable for operation on 208, 230 and 460 VAC, unless otherwise indicated on the electrical plans.
3. NEMA Design:

a. Electric Motors shall be NEMA Design B, (except as noted in equipment specifications for motors controlled as variable speed operation and other special motors), constant speed squirrel-cage induction motors having normal starting torque with low starting current.
b. In no case shall starting torque or breakdown torque be less than the value specified in NEMA MG 1.
c. Starting kilovolt ampere per horsepower shall not exceed values as specified in NEMA MG-1-10.37.
d. Motors shall be suitable for operation on the following starting mechanisms as shown on the drawings:

1) Across the line.
2) Reduced voltage solid state starter.
3) Variable frequency drive-inverter duty rated.
4) 2 speed 2 winding.

4. Insulation:

a. Comply with NEMA 1-1.65.
b. Motors shall be furnished with Class H insulation or with Class F insulation, rated to operate at a maximum ambient temperature of 40ºC and at the altitudes where the motors will be installed and operated, without exceeding temperature rise limits stated in NEMA MG1-12.42 for Class B insulation at a 40º C ambient, and without using the service factor.

5. Motor Bearings:

a. Antifriction, re-greaseable, and filled initially with grease suitable for ambient temperature to 40ºC.

1) Suitable for intended application and have AFBMA B-10 rating L-10 life of 60,000 hours or more.
2) Bearing mounting shall be designed with easily accessible grease supply, flush, drain, and relief fittings using extension tubes where necessary.

C. Vertical Motors

1. Comply with the requirements for three phase motors except where the following requirements are more stringent.
2. Enclosure:

a. All vertical motors installed outdoors shall have Weather Protected Type II (WPII) enclosures.
b. All vertical motors installed indoors shall have Weather Protected Type I (WP I) enclosures.

3. All vertical motors shall have a Service Factor of 1.15.
4. Motor Bearings:

a. Antifriction, oil lubricated, and filled initially with oil suitable for ambient temperatures to 40º C.

1) Suitable for intended application and have AFBMA B-10 rating life of 60,000 hours or more.
2) Bearing mounting shall be designed with easily accessible oil supply, flush, drain, oil level gauge, and relief fittings using extension tubes where necessary.

b. Furnished with re-lubricate ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

2.4 COMPONENTS

A. Motor Enclosures:

1. Open Drip Proof:

a. Stamped steel conduit boxes.
b. 1.15 service factor at 40º C ambient.

2. Totally Enclosed Fan Cooled:

a. Cast iron conduit box.
b. 1.15 service factor at 40º C ambient
c. Tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller.
d. Automatic breather and drain devices for frames 324T and larger.
e. Upgraded insulation by minimum of 3 dips and bakes and sealer coat of epoxy or silicone.

3. Severe Duty:

a. Corrosion resistant type conforming to motors designated by manufacturer as:

   1) Chemical Duty.
   2) Mill and Chemical.
   3) Custom Sever Duty.
   4) Or similar applicable manufacturer's quality designation.

b. 1.15 service factor at 40º C ambient.
c. Tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller.
d. Automatic breather and drain devices for frames 324T and larger.
e. 2 cycles of vacuum epoxy impregnation of the motor windings.

2.5 ACCESSORIES

A. Conduit Boxes

1. Horizontal motors 3 HP and larger, and all vertical motors, shall have split-type cast metal conduit boxes.
2. Boxes on motors other than open drip-proof shall be gasketed.
3. Boxes shall be furnished with the size and number of openings as required for the conduits indicated on the Drawings.
4. Boxes shall be rotatable through 360 degrees in 90 degree increments.
5. Shall be furnished with an integral equipment ground lug installed and sized as required for the conductors indicated on the Drawings.

B. Lifting Devices: All motors weighing 265 lb (120 Kg) or more shall have suitable lifting devices for installation and removal.

C. Space Heaters:

1. All motors 1 HP and larger shall be furnished with winding heaters where installed outdoors.
2. Space heater ratings shall be 120 volts, single-phase, unless otherwise shown.
3. Bring power leads for heaters into conduit box.

D. Nameplate:

1. All motors shall be fitted with a permanent, stainless steel nameplate indelibly stamped or engraved with:

    a. NEMA Standard motor data.
    b. Bearing description and lubrication instructions.
    c. Insulation class.
    d. Ambient temperature.
    e. Altitude rating.
    f. Power factor at full load.

2.6 CURRENT BALANCE

A. Current unbalance on polyphase motors shall not exceed the values tabulated below when motor is operating at any load within its service factor rating and is fed by a balanced voltage system:

1. Under 5 horsepower: 25 percent
2. 5 horsepower and above: 10 percent

2.7 OVER-TEMPERATURE PROTECTION

A. General

1. Over-temperature protection devices shall provide a normally closed contact rated NEMA ICS Class B1 50. Relays or solid state contacts which are required shall be provided in an enclosure on or near the motor. Relay enclosure shall be in accordance with NEMA ICS-6 and shall be NEMA 4 for all motors.

B. Requirements

1. Over temperature protection is not required for motors rated less than 25 horsepower.
2. Over temperature protection for motors rated 25 horsepower or greater but less than 200 horsepower shall be thermal switches, NEMA MG 1-12.57, Type 2.
3. Over temperature protection for motors rated 250 horsepower or greater shall consist of a minimum of six 100 OHM Platinum RTD’s embedded in the motor windings, and one 100 OHM for each bearing. Wiring to an external junction box shall be provided. Motor supplier shall coordinate with motor controller supplier to ensure RTD’s match Multilin 369 requirements.

2.8 SHAFT CURRENT PROTECTION

A. All motors coupled with a variable frequency drive (VFD) shall include a shaft grounding system. Acceptable systems include Mercotac Rotary Electrical Connectors, AEGIS SGR, or equal.

PART 3 - EXECUTION

3.1 TESTING

A. Each motor shall be given a routine commercial test as required by NEMA MG 1 to demonstrate that it is free from electrical or mechanical defects. Copies of routine test reports shall be submitted in the format specified by NEMA.

END OF SECTION

SECTION 26 09 13
CONTROL DEVICES

PART 1 GENERAL

1.1 GENERAL

A. This section sets forth the general specification and requirements for the control devices that shall be provided with control panels, motor starters, and other enclosures in order to assemble a complete and operable control, alarm, or indicating system.
B. The SUPPLIER shall coordinate the installation of items specified herein as required to ensure the complete and proper interfacing of all the components and systems.

1.2 APPLICABLE SECTIONS

A. The General Conditions, Supplementary General Conditions, Special Conditions, alternates and Addenda, applicable drawings and the technical specification herein shall apply to work under this Section.

1.3 APPLICABLE REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1. NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
2. NEMA 250 (1985; Incl. Rev. I and 2; ICS-6) Enclosures for Electrical Equipment
3. NEMA ICS 1 (1988) General Standards for Industrial Controls and Systems
4. UNDERWRITERS LABORATORIES, Inc. (UL)
5. UL 50 Enclosures for Electrical Equipment
6. UL 508 Industrial Control Equipment

1.4 SUBMITTALS

A. Provide complete submittal information for the control devices in accordance with Section 26 05 00.
B. Comply with the following requirements:

1. Submit certified dimensional drawings and manufacturer's data sheets for each size and type of device specified herein to be utilized. Data sheets are to be highlighted to define the specific materials of construction and features specified herein along with detailed manufacturer's model number.
2. Submit instruction bulletins for each type of control device. The instruction bulletins shall include installation instructions, wiring diagrams, power requirements, maintenance instructions, calibration instructions, and any other details of a specialized nature to the devices furnished.

C. Additional submittal requirements:

1. Circuit Breakers and/or fuses:
   a. Provide a complete schedule showing load and rating of circuit breakers and/or fuses.
2. Control power transformers and/or power supplies:
   a. Provide complete sizing calculations in accordance with the requirements identified herein.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Named manufacturers have been indicated for various specified devices to establish the standard of quality and performance of the equipment to be supplied.
B. Devices of a given type shall be of the same model, class, or rating, have the same general appearance, and be from the same manufacturer.

2.2 GENERAL REQUIREMENTS

A. Analog measurements and control signals shall:

   1. Be electrical as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted.
   2. Electrical signals outside control panels shall be 4 to 20 mA DC, except as noted.
   3. Signals within enclosures may be 1 to 5 VDC, or 0-10 VDC.
   4. Dropping resistors shall be installed at all field side terminations in the control panels to ensure loop integrity.

B. Control panels provided with integral power supplies and control power transformers shall be configured to match the voltage and current requirements of the loads.
C. Each 120 VAC control loop or instrument shall have an individual circuit breaker or fuse within its respective control panel and clearly identified for function.
D. Each PLC output shall have its own individual fuse external of the I/O card, with blown fused indication.

   1. Size external fuse to open before any I/O card mounted fuses.

E. Signal isolators, Signal Converters, and Power Supplies:

   1. Signal isolators shall be furnished and installed in each measurement and control loop, wherever required:
      a. To ensure adjacent component impedance match.
      b. Where feedback paths may be generated.
      c. To maintain loop integrity when the removal of a component of a loop is required.
   2. Signal converters shall be included where required to resolve any signal level or signal type incompatibilities.
   3. Power supplies shall be included, as required by the device manufacturers' load characteristics, to ensure sufficient power to each loop component.

2.3 CONTROL DEVICES

A. Signal Isolators and Converters.

1. Signal isolators shall have complete isolation of input, output and power input.
   a. Signal input shall be 4-20 mA into 50 ohms, maximum.
   b. Signal output shall be 4-20 mA into 1000 ohms, minimum.
   c. Power input shall be 120 VAC, 60 Hz or 24 VDC.
   d. Span and zero shall be adjustable.
   e. Accuracy shall be ±1 percent of span.
   f. Units shall be surface or DIN rail mounted.
2. Signal Converters
   a. Signal inputs of 1-5 V, 0-10 V, ect.
   b. Signal output shall be 4-20 mA into 1000 ohms, minimum.
   c. Power input shall be 120 VAC, 60 Hz or 24 VDC.
   d. Span and zero shall be adjustable.
   e. Accuracy shall be ±1 percent of span.
   f. Units shall be surface or DIN rail mounted.
3. Acceptable manufacturers:
   a. Accromag.
   b. AGM Electronics Model TA-4000.
   c. Or approved equal.

B. Relays

1. General Purpose Relays:
   a. General purpose relays shall be plug-in type.
   b. Contacts rated 10 amperes at 120 volts AC.
   c. With LED indication when energized.
   d. Quantity and type of contacts shall be as shown on the Plans or as needed for system compatibility.
   e. Each relay shall be enclosed in a clear plastic heat and shock resistance dust cover.
   f. Sockets for relays shall have screw type terminals.
   g. Provide transient surge protection across the coil of each relay.
   h. Relays shall be:
      1) Potter and Brumfield Type KRP or KUP.
      2) IDEC.
      3) Square D Type K.
      4) Allen Bradley.
      5) Or approved equal.
2. Slave and Interposing Relays:
   a. Additional slave relays shall be provided when the number or type of contacts shown exceeds the contact capacity of the specified relays and timers.
   b. Additional relays shall be provided when higher contact rating is required in order to interface with starter circuits or other equipment.
   c. Shall be provided to compensate for voltage drop due to long wire runs.
   d. The slave and interposing relays shall be as the general purpose relays.
   e. Provide transient surge protection across the coil of each relay.

3. Time Delay Relays
    a. Time delay relays shall be pneumatic on-delay or off-delay type.
    b. Contacts shall be rated 10-amperes at 120 VAC.
    c. Units shall be including adjustable dial with graduated scale covering the time range in each case.
    d. Provide transient surge protection across the coil of each relay.
    e. As manufactured by Agastat, Series 7000.

C. Manual Operators and Interface Devices - Unclassified Areas

1. General Requirements
    a. NEMA Type 13 Oil tight.
    b. With synthetic rubber gasket.
    c. Heavy duty.
    d. Industrial grade full size 1 – 13/64" diameter.
2. Pushbutton Units:
    a. Contacts rated:
        1) NEMA A600.
        2) 600 VAC maximum.
    b. Color Code:
        1) Red - Stop
        2) Green - Start
        3) Orange - Open
        4) Blue - Closed
    c. As manufactured by:
        1) Allen Bradley 800T.
        2) Square D Type K.
        3) Cutler-Hammer 10250T Series.
    d. Furnish one spare normally open and normally closed contact with each switch.
3. Selector Switches:
    a. Contacts rated:
        1) NEMA A600.
        2) 600 VAC maximum.
    b. As manufactured by:
        1) Allen Bradley 800T.
        2) Square D Type K.
        3) Cutler-Hammer 10250T Series.
    c. Furnish one spare normally open and normally closed contact with each switch.
4. Pilot Lights:
    a. Transformer type LED pilot lights.
    b. 120 VAC.
    c. Push to Test type.
    d. As manufactured by:
        1) Allen Bradley.
        2) Square D Type K.
        3) Cutler-Hammer 10250T Series.

D. Manual Operators and Interface Devices - Corrosive Areas

1. General Requirements:
   a. NEMA 4X corrosion resistant.
   b. Exterior parts to be made of high impact strength fiberglass reinforced polyester or other corrosion resistant materials.
   c. Incorporating an internal neoprene boot which completely encloses all internal parts.
   d. Industrial grade full-size 1 – 13/64" diameter.
2. Pushbutton
   a. Having an integral wiping gasket around the pushbutton that cleans the wall of the pushbutton guard of any foreign material accumulation as the button is operated.
   b. Contacts rated:
      1) NEMA A600.
      2) 600 VAC maximum.
   c. Color code:
      1) Red - Stop
      2) Green - Start
      3) Orange - Open
      4) Blue - Closed
   d. As manufactured by:
      1) Allen Bradley NEMA 4, 4X – 800H.
      2) Crouse Hinds NPB1211.
      3) Cutler-Hammer E34 Series.
      4) Square D Type SK.
3. Selector Switches:
   a. Contacts rated:
      1) NEMA A600.
      2) 600 VAC maximum.
   b. As manufactured by:
      1) Allen Bradley NEMA 4, 4X-800H.
      2) Crouse Hinds NW 12221.
      3) Crouse Hinds NSW 12321.
      4) Cutler-Hammer E34 Series.
      5) Square D Type SK.
   c. Furnish one spare normally open and normally closed contact with each switch.
4. Pilot lights:
   a. Transformer type LED pilot lights.
   b. 120 VAC.
   c. Push to test.
   d. Light colors shall be as identified on the Plans.
   e. As manufactured by:
      1) Allen Bradley NEMA 4, 4X-800H.
      2) Crouse Hinds NW 12221.
      3) Crouse Hinds NSW 12321.
      4) Cutler-Hammer E34 Series.
      5) Square D Type SK.

E. Terminal Blocks

1. Din rail mounted.

2. Terminal to be of the tubular screw type with pressure plate to minimize the possibility of breaking wire strands during tightening.
3. Recessed terminal hardware to minimize the possibility of contact with current carrying parts.
4. Molded of high dielectric material.
5. Minimum rating 600 VAC, 30 amp.
6. External connections to and from all control panel must be via terminal blocks, including power, control, alarm, instrumentation, monitoring, and solenoid circuits.
7. Individual terminals and terminal blocks shall be marked in a permanent manner with printed identification.
8. As manufactured by:
   a. Entrelec M 4/6
   b. Phoenix Contact UK 5 N
   c. Or approved equal

F. Conductors within Control Panels

1. Single conductors shall be as follows:
   a. Material: Soft annealed coated copper per ASTMB33 or B189.
   b. Standard: ICEA S-19-81.
   c. Stranded Wire - Class B.
   d. Insulation and Coverings:
      1) Thickness: Per ICEA.
      2) Material:
         a) No. 8 and Smaller: Type XHHW single conductor, copper power cable, moisture resistant, flame retardant thermoplastic insulation, 600 volt, 75 °C.
         b) No. 6 and larger: Type XHHW-2 single conductor, copper power cable, heat and moisture resistant, flame retardant, thermoplastic insulation, 600 volt, 75°C.
   e. No. 14 AWG minimum, shall be used for field control circuits, unless otherwise noted.
   f. No. 16 AWG minimum, Type MTW shall be used for all PLC I/O connections within the panel; between I/O device and field wiring terminal blocks.
2. Instrumentation Cable (Shielded Twisted Pair STP):
   a. Minimum conductor size 18 AWG.
   b. Stranded and tinned copper conductors.
   c. Polyethylene conductor insulated.
   d. Foil aluminum-polyester shield – 100% shielding.
   e. Minimum 18 AWG, stranded, tinned, copper drain wire.
   f. PVC outer jacket.
   g. UL Listed, TC rated.
   h. 600 volt insulation level.

G. Wire markers

1. Conductors within the control panel are to be permanently marked with wire numbers at each end.
2. Wire numbers are to correspond to the wire numbers indicated on the submittal drawings and are to correspond to the terminal block number to which they are attached in the control panel.

3. Markers shall be heat shrinkable tubing, imprinted type wire markers.
4. Manufacturers:
   a. 3M.
   b. Thomas & Betts.
   c. Panduit.

H. Nameplates

1. Nameplates: Engraved three-layer laminated plastic, white letters on black background.
2. Control components within the control panel shall have nameplates secured with stainless steel screws. Nameplates cannot be attached to the covers of the panel wireways.
3. The enclosure and components on the front cover or interior swing out panels shall be identified by nameplates.
   a. Use standard manufacturer engraved nameplates for all pushbuttons, and selector switches only if color matches that specified for engraved nameplates. If not, then furnish nameplates to match colors as specified herein.
   b. Use engraved plastic laminated nameplates for all other devices, displays, keypads, and annunciator LED's.
   c. For NEMA 12, 4, and 4X enclosures, use an epoxy based adhesive to affix nameplates to enclosure cover.
4. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, power supply, relay, terminal strips, and the like mounted inside the panel. The nameplate nomenclature shall match the component names identified in the submittal drawings.
5. Lettering, styles, abbreviations and sizes shall be in conformance with ISA-RP-60.6 (1984) with an intended viewing distance of 3 to 6 feet for external nameplates and 1 to 2 feet for internal nameplates.

I. Control Circuit Breakers

1. Each 120 VAC control circuit, instrument, or loop shall be powered from an individual control circuit breaker.
2. Din rail mounted using the same DIN rail as used for the terminal blocks.
3. Manual ON-OFF Switch.
4. Rated 240 VAC.
5. Rated 2000 AIC.
6. Current ratings as needed load served.
7. Provide complete nameplate identifying each circuit.
8. As manufactured by:
   a. ABB
   b. Phoenix Contact
   c. Entrelec
   d. Square D

J. Fused Terminals:

1. Isolate all PLC Digital Outputs with fuses.
2. Isolate all PLC Digital Inputs with fuses.
3. Isolate all PLC Analog Inputs and Outputs with fuses.

4. Coordinate fuse size to be as recommended by the manufacturers. For PLCs, the fuse size to be below internal output protection of the PLC output module.
5. Fuses to be terminal block mounted.
6. Furnish nameplate identifying each fused terminal.
7. As manufactured by:
   a. Entrelec
   b. Phoenix Contact
   c. Or approved equal

K. Field / Remote Connections:

1. Field/remote connections shall be made at terminal blocks within the panel.
2. Furnish an individual terminal block space for each wire.
   a. Two wires on one terminal block will not be allowed.
3. Furnish an empty wire channel on the backpanel adjacent to the field/remote terminal block strip to be used to route the field/remote wires to the connection terminal blocks.
4. Provide spare terminal blocks as specified herein.

L. Control Voltages:

1. Control voltage shall be supplied via control circuit breakers in the panel.
2. Control power shall be sourced from the 120V power supplied to the panel, unless otherwise noted in the Plans.
3. AC control voltages other than that supplied shall be transformed via a control power transformer within the panel. DC control voltages shall be supplied by AC to DC power supplies, specified herein.

M. Control Power Transformers:

1. Low impedance type.
2. The control power transformers shall have fused over current protection on both the primary and secondary sides of the transformer.
3. Use actual coil power factors in calculating the VA rating of the transformer. Use a power factor of 35% if power factor of coils is unavailable.
4. Determine the continuous VA rating of the transformer based on maximum sealed VA load current from the coils of the starters, relays, and pilot lights. Maximum inrush current shall be calculated based on the maximum inrush of devices that can be energized at one time plus the load presented by the devices already energized, and the actual power factor of the loads. This maximum inrush current must not cause the secondary voltage of the transformer to fall below 85% of rated voltage when the primary voltage has been reduced to 90% of rated voltage. Based on these calculations then actual transformer size shall be the calculated value times 1.5.

N. Transient / Surge Protection

1. Data and Signal Line Protectors to be used on each and every analog input or output, and on each and every data and signal line external connection point:
   a. Provide electronic circuits and components from damaging surge voltage and currents.

b. Provide protection of signal and data lines associated with computer, data, communications, instrumentation, broadcasting, and industrial control interfaces.
c. Shall be used directly with EIA standard interfaces:
    1) RS-232
    2) RS-422
    3) RS-423
    4) RS-485
    5) 4-20 mA instrumentation loops.
d. Repeatedly provide protection against surge currents in excess of 10,000 Amps.
e. DIN rail mounted.
f. Cable shields shall be passed through and may be either grounded or not grounded at the protector.
g. System:
    1) Heavy duty multi-staged protectors.
    2) Solid state stage intercepts the leading edge of the surge with sub-nanosecond response time.
    3) Within micro-seconds, a 3-pole common chambered gas tube capable of handling 20,000 ampere lightning current operates and crowbars the surge to ground.
    4) The protector remains in the crowbar state until the surge has passed and line voltages return to safe levels.
h. Location:
    1) Place at each end of a signal line, data line, or current loop.
    2) In the case of daisy chain configuration, such as RS-485, protectors shall be placed at each node.
i. Electrical Characteristics:
    1) Surge Life:
        a) Greater than 1000 operations with 200 Amps, 10 x 100 µsec.
        b) Greater than 10 operations with 10,000 Amps, 8 x 20 µsec.
    2) Leakage current at rate line to ground voltage < 10 µAmps.
    3) Signal/Data attenuation at maximum data rate 3 db with 600 terminations.
    4) Operating temperature -40°C to +60°C.
j. As manufactured by:
    1) Joslyn:
        a) For differential signals, such as RS-422 or RS-485, and current loops – Model 1820.
        b) For high frequency differential signals and current loops – Model 1821.
        c) For line to ground protection, two separate circuits, and ground referenced signals (RS-232) and 4-20 mA loops where the return wire is grounded at the protector – Model 1810.
        d) For high frequency line to ground protection, two separate circuits, and ground referenced signals (RS-232) and 4-20 mA loops where the return wire is grounded at the protector – Model 1811.

2. Protection from inductive spikes within the control panel.
    a. Provide surge protection across all inductive coils for control relays, starters, solenoids, etc.

O. Power Supplies: Power supplies shall convert 120 VAC ±10% to 24 volt DC or other DC voltages as necessary.

1. Power supplies shall have an excess rated capacity of 40 percent or be rated 100 watt minimum.
2. The failure of a power supply shall be annunciated at the control panel and repeated to the SCADA system through a connection to PLC.
3. Output regulation shall be accurate within ±0.05% for a 10% line change or a 50% load change and shall include remote voltage sensing.
4. The power supply shall be rated for temperatures of 32 to 122 degrees F and shall be UL recognized.
5. Power supplies shall have fully isolated primary and secondary coils which shall be surrounded by an insulating enclosure which shall also provide mechanical isolation.
6. All power supplies shall be designed and configured as fully redundant systems so that the failure of one power supply will automatically transfer to the other power supply with no interruption in power.
   a. The power supply failure shall supply a dry contact for connection to a PLC input for an alarm indication.
7. As manufactured by:
   a. Power One W Series.
   b. Phoenix Contact Quint Series.
   c. IDEC Slim Line.

PART 3 EXECUTION

3.1 INSTALLATION

A. Conform to all application provisions of the NEMA and UL standards, NEC and local, state, and federal codes when fabricating the equipment.
B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Locate devices, including accessories, where they shall be accessible from grade, except as shown otherwise.
C. Mount components in accordance with the installation details as prepared by the manufacturers.
D. Mount equipment so that each device is rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment within the panel.
E. Items, components, devices, and accessories shall be mounted and anchored using stainless-steel hardware, unless otherwise noted.

3.2 SPARES

A. Unused inputs and outputs from the PLC shall be wired to field terminal blocks and identified.

B. Furnish one spare normally open and one spare normally closed dry contact for each push-button, selector switch, relay, etc.
C. Furnish ten spare fuses for each type of fuse in the panel.
D. Furnish 15 spare terminal blocks or 20% whichever is greater.
E. Furnish five spare relays for each type used in the panel.
F. Spare contacts of relays, switches, etc., shall be internally wired to terminal blocks.

- END OF SECTION -

SECTION 26 16 00
PANELS AND CONSOLES

PART 1 - GENERAL

1.1 SUMMARY

A. General: This section sets forth the general specifications and requirements for all the control panels and enclosures being provided under this contract.

1. Including but not limited to all:
   a. All custom built and designed control panels.
2. The CONTRACTOR shall furnish, supply and install all custom panels for this project in accordance Contract documents.
3. This section also covers requirements for local control panels being supplied by the Equipment Manufacturers as part of the packaged equipment.
1. This specification covers the requirements for the fabrication of instrument panel boards or enclosures, mounting, finishing, piping and wiring of instrument equipment.

B. Related Sections:

1. The Contract Documents are a single integrated document, and as such all Divisions and Section apply. It is the responsibility of the CONTRACTOR and its Sub-Contracts to review all sections to insure a complete and coordinated project.

1.2 PANEL FABRICATION

A. The following paragraphs describe general fabrication requirements for the instrument panels, enclosures, and subpanels:

1. All internal instrument and component device wiring shall be as normally furnished by the manufacturer. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 C.
2. Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring and wiring for control circuits shall be minimum 14 AWG. Annunciator and indicating light circuits shall be minimum 16 AWG. Electronic analog circuits shall be 16 AWG twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color-coding legend on the system supplier's panel wiring diagrams.
3. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 volts ac with a nominal clamping voltage of 200 volts. Surge protectors shall be a non-faulting and non-interrupting design with a response time of not more than 5 nanoseconds. Surge protectors shall be Transtector "ACP-I00BW", Power Integrity Corporation "ZTAS”, or equal.

4. Terminal blocks for external connections shall be suitable for No. 12 AWG wire, and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the Supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits plus one ground for each shielded cable. All wiring shall be grouped or cabled and firmly supported to the panel. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
5. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic drawings.
6. Nameplates shall be provided on the face of the panel or on the individual device as required. Panel nameplates shall have approximate dimensions and legends as indicated on the drawings and shall be made of laminated phenolic material having engraved letters approximately 3/16 inch high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel.
7. All panels shall be thoroughly cleaned, sanded, and given not less than one coat of rust-inhibiting primer both inside and out. The panel interior shall be given not less than one coat of white enamel or lacquer. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be smoothed and given not less than two coats of enamel, polyurethane, or lacquer finish. Color samples shall be submitted to the Engineer for color selection. One quart of finish color paint shall be furnished with the panels to cover future scratches.

B. FACTORY TEST

1. Panels shall be factory-tested electrically and pneumatically by the panel fabricator in the presence of the ENGINEER before shipment.

1.3 SUBMITTALS

A. Control Panel Engineering Submittals: Submit a two-phase control panel engineering submittal for each and every control panel and enclosure being provided for this project.

1. Phase I shall be the Control Panel Hardware submittal which shall include but not be limited to:
   a. Enclosure construction details and NEMA type.
   b. Finish, including color chart for ENGINEER selection of color.
   c. Layout.
   d. Power circuits.
   e. Signal and safety grounding circuits.
   f. Fuses.
   g. Circuit breakers.
   h. Signal circuits.
   i. Internally mounted instrumentation.
   j. Face plate mounted instrumentation components.
   k. Internal panel arrangements.

l. External panel arrangements.
m. Construction drawings drawn to scale which define and quantity.
    1) The type and gage of fabrication steel to be used for panel fabrication.
    2) The ASTM grade to be used for structural shapes and straps.
    3) Panel door locks and hinge mechanisms.
    4) Type bolts and bolt locations for section joining and anchoring.
    5) Details on the utilization of "UNISTRUT" and proposed locations.
    6) Stiffener materials and locations.
    7) Electrical terminal box and outlet locations.
    8) Electrical access locations.
    9) Print pocket locations.
    10) Writing board locations.
    11) Lifting lug material and locations.
n. Physical arrangement drawing drawn to scale which define and quantity the physical groupings comprising:
    1) Control panel sections.
    2) Auxiliary panels.
    3) Subpanels.
    4) Racks.
    5) Cutout locations with nameplate identifications shall be provided.
o. A bill of material which enumerates all devices associated with the control panel.

2. Phase II shall be the Control Panel Wiring Diagram submittal which shall include but not be limited to:
    a. Schematic/Elementary diagrams shall depict all control devices and circuits and their functions.
    b. Wiring/Connection diagrams shall locate and identify:
        1) Electrical devices.
        2) Terminals.
        3) Interconnecting wiring.
        4) These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
    c. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment.
        1) These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.
    d. Control sequence diagrams shall be submitted to portray the contact positions or connections required to be made for each successive step of the control action.
3. All panel drawings shall be 22" x 34" reduced to and fully legible at 11" x 17", and submitted at 11" x 17" format size, with all data sheets and manufacturer specification sheets being 8.5" x 11".
4. The submittal shall be in conformance with NEMA Standard ICS-1-1.01, and each phase shall be submitted as a singular complete bound volume or multi-volume package and shall have the following contents.
    a. A complete index shall appear in front of each bound volume.
        1) All drawings and data sheets associated with a panel shall be grouped.
        2) All panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.

b. Completed ISA-S20 data sheets for all instrumentation devices associated with each control panel supplemented with manufacturer specification sheets which verify the products conformance to the requirements of the Contract Documents.
c. A listing of spare parts in conformance with each equipment specification section.

1.4 QUALITY ASSURANCE

A. Environmental Suitability:

1. All indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designed in the Contract Documents.
2. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices to within a range equal to 20% above the minimum and 20% below the maximum of the rated environmental operating ranges.
3. Provide all power wiring for these devices.
4. Enclosures suitable for the environment shall be furnished.
5. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.

B. All control panels and assemblies shall be labeled and listed by a nationally recognized testing laboratory.

1. Underwriters Laboratory, Inc.
2. Or equal.

1.5 DELIVERY, STORAGE AND HANDLING

A. All panels are to be crated for shipment using a heavy framework and skids.

1. The panel sections shall further be cushioned satisfactorily to protect the finish of the instruments and panel during shipment.
2. All equipment which is shipped with the panel shall further have suitable shipping stops and cushioning material installed in a manner to protect instrument parts which could be damaged due to mechanical shock during shipment.

PART 2 – PRODUCTS

2.1 CONTROL PANELS

A. The following paragraphs describe specific requirements for the control panels:
B. CONSTRUCTION - NEMA 4X or equal in process or humid areas.

1. Pilot device groupings where the removed metal exceeds 50% of the available metal in an area bound by a 3” envelope around said pilot devices.
   a. Finish.
      1) Interior, smooth, polyester power coating.
      2) Exterior polyester powder coating gray in color.

a) Panels that re in the same room as, motor control centers, switchboards, etc shall be of the same color as the motor control center or switchboards so that the control panel blends into the line up.

b. Manufacturer's standard gauge steel.
c. Each door to have a three-point latching mechanism and padlocking handle with rollers on the ends of the latch rods.
d. With heavy duty lifting eyes.
e. With flange mounted disconnect.
f. Mounting panel
   1) 10 gauge steel
   2) With stiffeners

2. Water tight corrosion resistant stainless steel
   a. NEMA 4X in design, dust tight, water tight, and corrosion-resistant.
   b. 14 gauge, Type 304 Stainless Steel.
   c. Captive stainless steel cover screws threaded into sealed wells.
   d. Oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.
   e. Finish
      1) Cover surface and sides, unpainted, brushed finish.
   f. Door fronts ground smooth.
   g. Specifically designed for use with flange mounted disconnect switches.

B. SIZE AND ARRANGEMENT - Panel dimensions and general instrument arrangement shall be as indicated on the drawings.

C. Interconnecting wiring and wiring to terminals for external connection shall be MTW or SIS 16 AWG, stranded copper wire, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 degrees Celsius except for electronic circuits and special instrument interconnect wiring which shall be in accordance with manufacturer requirements. Provide a switched fluorescent light at every four feet of panel length.

D. PANEL WIRING:

1. Power distribution wiring on line side of panel fuses minimum 12 AWG.
3. Secondary power distribution wiring and wiring for control circuits: Minimum number 14 AWG.
4. Annunciator and indicating light circuits: Minimum 14 AWG.
5. Electronic analog circuits within instrument and control panels: Minimum 16 AWG twisted and shielded pairs or triads rated not less than 16 volts.
6. Provide a 15 amp, 120 volt GFCI service outlet within each panel.
7. Wire Insulation Colors:
   a. Conductors supplying 120-volts AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor.
   b. Grounded circuit conductors shall have white insulation.
   c. Insulation for ungrounded 120-volt AC control circuit conductors shall be red.
   d. All wires energized by a voltage source external to the control panels shall have yellow insulation.
   e. Insulation for all DC conductors shall be blue.
8. Wire Marking:

a. Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings.
b. These numbers shall be marked on all conductors at every terminal in accordance with Section 16120.

9. For case grounding, panels shall be furnished with a ¼-inch by 1-inch copper ground bus complete with solderless connectors for all equipment ground conductors.
   a. Refer to Division 16 – Conduit Schedule for size and number of conductors.
10. Power Supply Wiring:
   a. Each and every loop and instrument requiring 120 VAC shall be protected by individual DIN rail mounted circuit breakers.
      1) The number of circuits depends on the circuit load as noted herein.
      2) The circuit load shall not exceed 10 amp.
      3) Different panel section or different process units must not use common branch circuits.
      4) Furnish and install DIN rail mounted circuit breakers for all individual instruments.
         a) Circuit breakers shall be mounted on the back of the panel.
         b) Identified by a service name tag.
   b. Each potentiometer type instrument, electronic transducer, controller or analyzer shall have an individual DIN rail mounted circuit breaker located within the control panel.
      1) Circuit breakers shall have plastic tags indicating instrument tag numbers.
      2) Individual plug and cord set power supply connections require DIN rail mounted circuit breakers ahead of the receptacle.
11. Furnish circuit breakers for the panel lights, and for the panel receptacle.
12. Alarm Wiring:
   a. Install and wire all alarms including light cabinets, audible signal units, test and acknowledge switches and remote logic units as specified.
   b. Interconnecting wiring to panel mounted initiating devices shall also be wired.
   c. Where plug and cord sets are provided for component interconnection, harness and support the cables in neat and orderly fashion. Where separate wire is required, install No. 16 AWG with MTW or TFFN insulation between all components.
13. Signal Wiring:
   a. Signal Wire – Non Computer Use
      1) Signal wire shall be twisted pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG with MTW or TFFN insulation between all components.
      2) Color code for instrument signal wiring shall be as follows:
         a) Positive (+) – Black
         b) Negative (-) – White.
      3) Multiconductor cables where specified shall consist of No. 18 AWG copper signal wires twisted in pairs, pairs, with 90°C, 600 V insulation.
         a) A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.
      4) Use for connections between field terminal blocks and the PLC wiring arms for analog inputs and outputs.
   b. Signal Wire – Computer Use

1) Signal wires shall be similar to those for non-computer use but each pair shall be triplexed with a copper drain wire and aluminum polyester tape shall be applied over the triplexed group.
2) All cable shields, including thermocouple extension leads shall be terminated at a single point within the control panel.
3) Continuity of the shield is to be maintained throughout the cable runs.

c. Multi-conductor cables, wireways and conduit shall be sized to allow for 20 percent signal wire.

14. Wiring Installation:
a. All wires shall be run in plastic wireways.
b. Exception:
1) Field wiring.
2) Wiring run between mating blocks in adjacent sections.
3) Wiring runs from components on a swing-out panel to components on a part of the fixed structure.
a) Wiring run from components on a swing-out or front panel to other components on a fixed panel shall be made up in tied bundles.
b) These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the “hinge loop” so that conductors are not strained at the terminals.
4) Wiring run to front panel-mounted components.
c. Signal and low voltage wiring shall be run separately from power and 120 VAC control wiring.
1) 120 VAC circuits shall be run through grey colored plastic wireways.
2) 24 VDC circuits shall be run through white colored plastic wireways.
d. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.
e. Provide an empty wireway for all field wiring connections.
1) 120 VAC circuits shall be run through grey colored plastic wireways.
2) 24 VDC circuits shall be run through white colored plastic wireways.
f. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the ENGINEER’s review.

15. Grounding
a. Furnish equipment ground bus with lugs for connection of all equipment grounding wires.

B. ANALOG CIRCUITS AND AC POWER CIRCUITS: Separated.

C. INTERNAL PANEL WIRING COLORS:

1. AC Power Distribution: Red
2. DC Power and Control: Blue
3. Instrument: Black and white twisted shielded pair.
4. Other and in agreement with manufacturer's wiring diagrams as stated on manufactured drawing legend.

D. SURGE PROTECTION DEVICE FOR POWER ENTRANCES: Nominal 120 volts AC with a nominal clamping voltage of 200 volts; nonfaulting and noninterrupting design with a response time of

not more than 5 nano-seconds. Utilize a branch panel TVSS unit as described in Section 26 35 53.

E. TERMINAL BLOCKS FOR EXTERNAL CONNECTIONS: Suitable for specified AWG wire, rated 30 amperes at not less than 600 volts (for incoming power circuits, and for field 1/0 terminals they shall be Phoenix contact or equal as shown on the drawings); with marking strip, covers, pressure connectors, and labeled terminals, each conductor of external circuits plus one ground terminal for each shielded cable. Provide minimum 25 percent spare terminals.

F. Group cables, and firmly support wiring to the panel. Provide minimum 8 inches clearance between terminal strips and the base of vertical panels for conduit and wiring space. Individually fuse each control loop or system, and clearly label and locate fuses or circuit breakers for maintenance.

G. Furnish and install equipment grounding conductor in accordance with NEC 250. Provide power ground lugs. Provide signal insulated and isolated ground lugs.

H. Nameplates on Internal and External Instruments and Devices: Materials approximate dimensions with legends as indicated on the Drawings made of laminated phenolic material having engraved letters approximately 3/16 inch high extending through the black face into the white layer; firmly secured to panels.

I. POWER SUPPLIES/FUSING

1. Design and arrange regulated 24 volt DC power supplies for instrument loops so that loss of I loop does not affect more than one instrument loop or system. Provide power supplies suitable for an input voltage variation of plus or minus 10 percent. Fuse or short circuit protects the supply output.

16. Selectively fuse the power distribution from multi-loop supplies so that a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Label and locate fuses for easy access.

17. Output Voltage Regulation: As required by the instrument or control equipment being supplied.

18. Backup power supply units shall be provided to automatically supply the load upon failure of the primary supply. Design backup supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation.

19. Oversize the multi-loop supply systems for an additional 25 percent future load. Indicate failure of a multi-loop supply on the respective instrument panel or enclosure.

a. Furnish and install signal repeaters for instrument loops that exceed the load impedance of the power supplies. Indicating fuses: Neon bulb type for 120 VAC circuit and glass indicating fuse type for 24 VDC circuits.

J. SOURCE QUALITY CONTROL:

1. Functionally factory test instrument and control panel items electrically and pneumatically before shipment.

K. PANEL ACCESSORIES:

1. Manufacturers: Weidmuller SAKS; Entrelec; Phoenix Contact; Wago; or equal.
   a. Terminal Blocks: Nickel plated copper only; DIN rail; universal foot with the following as required for the application.
      1) Universal type
      2) Feed through
      3) Ground
      4) Neutral disconnect
      5) Intrinsically safe
      6) Explosion-proof
      7) Fuse
      8) Knife disconnect
      9) Ground fault indicator
      10) Bolt connecting
   b. Terminal Block Labeling: Each terminal and each conductor as previously specified with machine labels only.
      1) Manufacturers: Phoenix Contact; Entrelec; or equal.
         a) Signal Interface Modules:
            1. Analog isolating converter
            2. Ground loop isolations
            3. Signal amplification
            4. Signal level matching
            5. 24 VDC power supply (120 VAC input)

20. Disconnect Switches:
   a. Switches shall consist of a thermal magnetic circuit breaker with integral door operator – lockable
      1) Minimum 22 KAIC
      2) Not required for panels fed with 120 VAC or less. A nameplate must be furnished on the cover of the control panel identifying all sources of supply and foreign voltages within the control panel.
   b. The main disconnect shall disconnect all power sources within the control panel.
   c. Sized in accordance with the NEC and total connected horsepower and associated locked rotor currents.
   d. A disconnect shall be provided for each motor controller/starter within the control panel. This disconnecting means shall disconnect power and control power to each motor controller. Each disconnect shall be equipped with a dead front operator through either the cabinet door or a dead front panel.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 20 00
SERVICE AND DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.1 GENERAL

A. Provide all operations, methods, labor and equipment and provide and install all materials and incidentals necessary for the completion of the work as specified herein or included on the Drawings.

1.2 WORK INCLUDED

A. Electrical work required is indicated on the Drawings and specified herein and elsewhere includes, but is not necessarily limited to:

1. Complete electrical distribution systems for power, control, and instrumentation as shown.
2. Complete system of raceways, conductors, and equipment for all other auxiliary systems required. If noted, the equipment and wiring of these auxiliary systems will be furnished and installed under their respective sections; however, the conduit or raceway systems will be furnished and installed in accordance with Division 26 05 00.

B. The CONTRACTOR shall furnish and install all component parts of all the systems required for their safe and proper operation, whether or not specifically mentioned or noted on the Drawings, except those items or articles which are specifically noted as being supplied otherwise.
C. Perform all trenching and backfilling required in connection with the work which shall be in strict accordance with the provisions of Division 31 of these specifications.
D. Provide all required electrical conduits, conductors, and connections to items described in all other sections of these specifications.

1.3 APPLICABLE SECTIONS

A. The General Conditions, Supplementary Conditions, Special Conditions, Alternates and addenda, applicable drawings and the technical specifications herein shall apply.

1.4 ELECTRICAL SERVICE

A. New underground electrical service(s) from the local utility shall be at 480/277 volt, three phase, four wire, 60 hertz AC with current ratings as indicated on the Drawings.
B. The CONTRACTOR shall install service conduits and conductors from the utility transformer location to the service entrance section. The installation shall be in accordance with the utility company's published requirements. The CONTRACTOR shall coordinate the installation with the utility.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation of the service entrance sections shall be in accordance with the manufacture's requirements.

3.2 INSTALLATION OF GROUNDING ELECTRODE SYSTEM

A. The service entrance section shall be bonded to the grounding electrode system (GES). The GES consists of, but not limited to, the metal underground water pipes, metal frame of the building or structure, concrete encased electrode (UREF), ground rings, rods, pipe, or plate electrodes, and other metal underground systems or structures as in compliance with the NEC. Provide bonding jumper same size as system ground to provide ground continuity from customer's side of metallic lines service entrance and street side of metallic mains. The neutral (grounded conductor) and grounding electrode system shall be connected together at the service disconnect only.

B. The UFER ground system consists of a bare copper conductor, size as indicated in the Drawings, concrete encased 2" above the bottom of the foundation footing of the building or structure which is in direct contact with earth. The UFER ground will make a complete loop in the foundation and is bonded to the rebar steel at least in two locations. UFER ground connections shall be exothermic welds.

C. The equipment grounding system shall be such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with the electrical circuits operate continuously at ground potential and provide a low impedance path for the possible ground fault currents. The system shall comply with the National Electrical Code, modified as indicated on the Drawings or specifications.

D. The distributions system shall be provided with a separate equipment grounding conductor for each single or three-phase feeder, each branch circuit, each motor circuit, control or instrument raceways as indicated. The grounding conductor shall be installed in the common raceway with the related phase and/or neutral conductors. Flexible conduit equipment connections utilized in conjunction with branch circuits or feeders shall be provided with suitable bonding jumpers connected to listed grounding type fittings when required.

3.3 TESTING

A. General: Upon completion of this portion of the work, test all parts of the electrical system in the presence of the ENGINEER.

B. Test Requirements: All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than that required by the manufacturers.

3.4 FINAL INSPECTION

A. The CONTRACTOR shall be present at the final acceptance of the work by the OWNER.

B. The CONTRACTOR shall have pad and pencil to list all deficient items noted. Corrections and adjustments of deficient items shall be done after the inspection, not during.
C. See Section 26 05 00 for other requirements for final acceptance.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 26 22 00
DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE

A. This Section consists of dry type transformers and related items necessary to complete the work indicated within the Contract Documents.

1.2 REFERENCES

A. NEMA ST 1 – Specialty Transformers (Except General – Purpose Type).

B. NEMA ST 20 – Dry Type Transformers for General Applications.

C. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).

D. NFPA 70 – National Electrical Code.

E. UL – Underwriters Laboratories, Inc.

1.3 SUBMITTALS

A. In accordance with Section 26 05 00.

B. Product Data: provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type and rated temperature rise.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 DRY TYPE TRANSFORMERS

A. Transformers shall be premium high efficiency quiet type with copper windings, and shall be installed where indicated on the Drawings. The primary winding of the transformers shall have two 2-1/2 percent taps above, and below normal.

B. The transformers shall have a BIL of 10 KV with a temperature class of 185 degrees C for transformers up to 25 KVA, and a temperature class of 220 degrees C for larger transformers.

C. The sound level shall not exceed 44 dBa measured at 5 feet from the transformer after installation. Core and coil assemblies 30 KVA and larger, shall be mounted on rubber vibration isolators, designed to reduce harmonics generated noise.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit, 2 feet minimum length for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.

D. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

E. Mount trapeze-mounted transformers as indicated.

F. Provide grounding and bonding in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.

3.3 ADJUSTING

A. Adjusting installed work.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 26 24 16
BRANCH CIRCUIT PANELBOARD

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lighting and Appliance Panelboard - Furnish and install lighting and appliance panelboard(s) as specified herein and where shown on the associated schedules drawings.

1.2 REFERENCES

The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.

A. NEMA PB 1 – Panelboards
B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
C. NEMA AB 1 - Molded Case Circuit Breakers
D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
E. UL 50 - Enclosures for Electrical Equipment
F. UL 67 – Panelboards
G. UL 98 - Enclosed and Dead-front Switches
H. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
I. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
J. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
K. Federal Specification W-P-115C - Type I Class 1
L. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit And Service.
M. NFPA 70 - National Electrical Code (NEC)
N. ASTM - American Society of Testing Materials

1.3 SUBMITTAL AND RECORD DOCUMENTATION

A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

1.4 QUALIFICATIONS

A. Company specializing in manufacturing of panelboard products with a minimum of fifty (50) years documented experience.

B. Panelboards shall be manufactured in accordance with standards listed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inspect and report concealed damage to carrier within their required time period.

B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.

C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.6 OPERATIONS AND MAINTENANCE MATERIALS

A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

B. Refer to Sections 26 05 00 and 26 05 05 for additional requirements.

1.7 WARRANTY

A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.

1.8 RELATED WORK

A. Section 26 35 53 – Surge Protection Devices

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Square D Company Type NF - Class 1670.

B. Cutler Hammer / Eaton.

C. General Electric.

2.2 LIGHTING AND APPLIANCE PANELBOARD TYPE

A. Fabrication:

1. Interior

a. Continuous current ratings, as indicated on Drawings, not to exceed 600 amperes maximum for main breaker panelboards and not to exceed 800 amperes for main lug panelboards.

b. Minimum Short Circuit Rating: as indicated on the Drawings.

c. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing rated 100-400 amperes shall be plated copper. Bussing rated for 600 and 800 amperes shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.

d. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.

e. A solidly bonded copper equipment ground bar shall be provided.

f. Split solid neutral shall be plated and located in the mains compartment up to 250 amperes so all incoming neutral cable may be of the same length.

g. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twistouts covering unused mounting space.

h. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.

i. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers in 125A interiors shall be vertically mounted. Main circuit breakers over 125A shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.

j. Interior phase bus shall be pre-drilled to accommodate field installable options. (i.e., Sub-Feed Lugs, Sub-Feed Breakers, Thru-Feed Lugs)

k. Interiors shall accept 125 ampere breakers in group mounted branch construction.

2. Main Circuit Breaker

a. Shall be bolt-on type circuit breakers.

b. Main circuit breakers shall have an over center, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true RMS sensing and be factory calibrated to operate in a 40° C ambient environment. Thermal elements shall be ambient compensating above 40° C.

c. Two and three pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.

d. Circuit breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.

e. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.

f. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.

g. The circuit breakers shall be UL Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

3. Branch Circuit Breakers

a. Shall match panel manufacture. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the panelboard schedules drawings.

b. Molded case branch circuit breakers shall have bolt-on type bus connectors.

c. Circuit breakers shall have an over center toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.

d. There shall be two forms of visible trip indication. The circuit breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP® indicator appearing in the clear window of the circuit breaker housing.

e. The exposed faceplates of all branch circuit breakers shall be flush with one another.

f. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16.

g. Breakers shall be UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm Switch.

h. Breaker shall be UL Listed with the following ratings: (15-125A) Heating, Air Conditioning, and Refrigeration (HACR), (15-30A) High Intensity Discharge (HID), and (15-20A) Switch Duty (SWD)

4. Enclosures

a. Type 1 Boxes

1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.

2) Boxes shall have removable end walls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.

3) Box width shall not exceed 26" wide.

b. Type 1 Fronts

1) Front shall meet strength and rigidity requirements per UL 50 standards. Shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

2) Fronts shall be hinged 1-piece with door. Mounting shall be surface as indicated on associated drawings. All covers shall be hinged cover type.

3) Panelboards rated 250 amperes and below shall have MONO-FLAT fronts with concealed door hinges and trim screws. Front shall not be removable with the door locked. Panelboards rated above 250 amperes shall have vented fronts with concealed door hinges. Doors on front shall have rounded corners; edges shall be free of burrs.

4) Front shall have flat latch type lock with catch and spring loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.

c. Type 4, and 12

1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

2) All doors shall be hinged cover type. All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners on enclosures 59 inches or more in height. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.

3) Maximum enclosure dimensions shall not exceed 21” wide and 9.5” deep.

5. Surge Protective Device

a. Integral Surge Suppressor shall be provided for each branch circuit panelboard. See Section 26 35 53 for requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

3.2 FIELD QUALITY CONTROL

A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.

C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.3 INSTALLATION OF PANELS

A. Installation: Unless otherwise indicated on the drawings, install wall panels with the top of the trim 6'-0" above the finished floor. Panels located in equipment rooms and wire closets shall be surface mounted. Floor mounted panels shall be provided with a 4" concrete housekeeping pad. Floor mounted panels shall be anchored to floor at all four corners and to wall or structural member at top for seismic restraint.

B. Directories: Mount a typewritten directory behind glass or plastic on the inside of each panel door. On the directory, show the circuit number and complete description of all outlets with specific locations on each circuit. In addition, provide a typewritten label inside door showing source of power to panel to feeder switch, panel designation and location within buildings.

END OF SECTION

SECTION 26 26 00
TERMINAL BLOCKS

PART 1 GENERAL

1.1 GENERAL

A. A. This section covers terminal blocks for control and other wiring.

1.2 SUBMITTALS:

1.3 A. Products shall be submitted in accordance with Section 26 05 00, and elsewhere in the Contract Documents, prior to installation.

1.4 MANUFACTURERS:

A. Terminal blocks shall be Entrelec, Phoenix Contact, Weidmuller, or equal.
B. Surge protection blocks shall be MTL Surge Technologies, Series SD, or equal.
C. Power distribution blocks shall be Ilsco Corporation, or equal.

PART 2 PRODUCTS

2.1 TERMINAL BLOCKS

A. Terminal blocks shall mount on standard DIN rail, and be of the size required for conductors therein. A minimum of 25 percent spares shall be provided in each terminal box. No more than 2 conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power and signal commons. Terminal blocks shall be U.L. rated for 600 Volts, and 30 Amps, minimum.
B. Grounding terminal blocks shall be provided for instrumentation cable shields. The terminal blocks shall have distinctive 2-color bodies, and shall be mounted to the DIN rail with metal screw down type clamps, providing a positive ground connection. One grounding terminal block shall be installed for every 2 instrument cables terminated. Grounding terminal blocks shall be U.L. rated for 600 Volts, and 20 Amps, minimum.
C. Terminal blocks shall be available in a variety of colors, including red, green, blue, gray, black, yellow, and orange.
D. DIN mount fuse holders shall have blown fuse indicators for EC and AC circuits. Fuse holders shall be of the compression clamp type. Fuse holders shall be U.L. listed, and rated for 600 Volts. Fuse sizes shall not exceed the U.L. current rating for the fuse holders.
E. DIN rail shall be prepunched, zinc bichromate plated steel. Symmetrical DIN rail shall be 35 mmX7.5mm, minimum.

F. Terminal blocks for 4 to 20 milliamp signals shall have knife disconnect switches, and accessible test points for testing and measurement of current loop signals, without the need for removing wire terminations.

2.2 SURGE PROTECTION BLOCKS (SPB):

A. Analog inputs and outputs shall be terminated at surge protection blocks (SPB). The SPBs shall be designed for a working voltage of 32 volts, and shall be fused.
B. SPBs shall provide full hybrid line to line protection, and shall have a GDT rating of 10,000 A (8/20us pulse waveform).
C. SPBs shall be UL94 V-2 listed.

2.3 POWER DISTRIBUTION BLOCKS (PDB):

A. PDBs shall be Electro-tin plated and manufactured from high strength 6061-T6 aluminum alloy.
B. PDBs shall be UL Recognized rated 90º and CSA Certified.
C. PDBs shall provide flexibility in using the connector as an in line splice or to reduce conductor size.
D. PDBs shall be rated for 600 Volts and dual rated for Copper and Aluminum Conductor.
E. PDBs shall have the sizes and ratings per NEC.

PART 3 EXECUTION

3.1 INSTALLATION

A. Each terminal block and fuse holder shall be identified with the circuit number, or conductor number, corresponding to the identification appearing on the shop Drawings for the equipment, or system.
B. Terminal block and fuse holder markers shall be computer printed plastic-type, with permanent markings.
C. End clamps and end sections shall be installed on each terminal block and fuse holder assembly.
D. Terminal blocks for DC voltages shall be blue, and AC voltages shall be gray.

- END OF SECTION -

SECTION 26 28 13
FUSES

PART 1 GENERAL

1.1 GENERAL

A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

1. Fuses.
2. Spare Fuse Cabinet.

1.2 APPLICABLE SECTIONS

A. The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and Addenda, applicable drawings and the technical specifications including but not limited to the following:

1. Section 26 05 00 Electrical General Requirements
2. Section 26 05 19 Conductors and Cables

PART 2 PRODUCTS

2.1 FUSE TYPES AND RATINGS

A. Fuses from 0 to 600 ampere for each circuit serving a single motor shall be UL Class RK5 dual-element Low Peak, LPN-RK (250 volt), LPS-RK (600 Volt).
B. All other fuses in the 0 to 600 ampere range shall be UL Class RK5, dual-element, time delay, Iow peak, LPN-RK (250 volt), LPS-RK (600 Volt).
C. Fuses larger than 600 ampere shall be UL Class L with time delay, Hi Cap, KRP-C.
D. High voltage fuses - see drawings.

2.2 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Bussmann.
B. Other acceptable manufacturers: Gould Shawmut, Little Fuse.
C. All fuses shall be of one manufacturer. Fuses shall have a 200,000 ampere RMS symmetrical interrupting rating unless noted otherwise.

PART 3 EXECUTION

3.1 INSTALLATION

A. Motor circuits shall be fused. Fuses, 0 to 600 amperes, for 1.15 service factor motors shall be sized not exceeding 125% of motor full load amperes shown on nameplate. Fuses, 0 to 600 amperes, for all other motors shall be sized not exceeding 115% of motor full load amperes. Fuses above 600 amperes for all motors shall be sized up to 150% of motor full load amperes. Abnormal motor starting conditions requiring over sizing shall be coordinated with motor manufacturer.
B. Spare fuses shall be furnished for all fuse types. Spares shall amount to 10% of installed fuses with a minimum of one set of each fuse type and ampere rating. The set shall equal the number of poles in the appropriate switch.
C. Provide Spare Fuse Cabinet equal to Bussmann for storing spare fuses. Mount on wall in Equipment Room as directed by the ENGINEER.

- END OF SECTION -

SECTION 26 28 19
DISCONNECT SWITCHES

PART 1 GENERAL

1.1 GENERAL

A. Includes But Not Limited To

1. Furnish and install disconnects as described in Contract Documents, except those provided integral with equipment.

B. Related Sections

1. Section 26 05 00 Electrical General Requirements
2. Section 26 05 09 Electrical Identification
3. Section 26 28 13 Fuses

1.2 SUBMITTALS

A. Submit product literature including manufacturer part number, model number, material, size, ratings, and specifications.
B. Refer to Section 26 05 00 for submittal requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Manufacturer

1. Same MANUFACTURER as Motor Control Centers.

B. Disconnect Switches:

1. Heavy duty quick-make, quick-break type, fused, unless indicated otherwise. Provide a control switch for VFD fed motors which will disengage the VFD prior to opening the switch.
2. Provide interlock to prevent opening of door when switch is in ON position.
3. Provide means to lock switch in OFF position with padlock.
4. Disconnects for motor circuits shall be horsepower rated.
5. Where indicated on Drawings for small motors, disconnects shall be manual starter with thermal overload relay.
   a. Device shall have one pole per ungrounded conductor of motor.
   b. Provide overload relay to match motor full load amps.
   c. Equip with lockout device.
6. Enclosures:
   a. Interior Dry locations - NEMA Type 12, or as indicated or required.
   b. Exterior, Damp, or Wet Locations - NEMA Type 4X Stainless steel, or as indicated or required.
7. Fuses:

a. Fuse fused disconnects with dual-element time delay fuses and equip with rejection type fuse holders.
b. Fuses on shall be from single manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Label disconnects to indicate equipment served, such as Condensing Unit CU-1. Use 1/16 inch (1.6 mm) thick laminated plastic composition material with contrasting color core. Engraved letter shall be 1/4 (6 mm) inch high. Attach labels with screws.

- END OF SECTION -

SECTION 26 29 23
PULSE WIDTH MODULATED VARIABLE FREQUENCY DRIVE

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide all labor, materials, equipment and incidentals required and install, place in operation and field test 6 pulse or 18 pulse variable frequency drive.
B. The adjustable frequency controller shall be a flux vector sine-wave, pulse width modulated (PWM) design. A modulation method which incorporates “gear changing” is not acceptable. The final responsibility of the completed drive system is that of the manufacturer. Qualified system integration will be by manufacturers approved and should use methods and procedures approval in writing by the VFD manufacturer prior to shipping the drive system to customer site. One manufacturer shall provide all drives systems under this contract. The drive systems shall be manufactured within the United State of America to alleviate concerns of future spare part availability and technical support. All drive systems shall be purchased and furnished by the CONTRACTOR.
C. Drives for motors up to and including 60 HP shall be 6 pulse configured with harmonics mitigation. Drives over 60 HP shall be 18 pulse type or obtain equivalent harmonics mitigation.

1.2 QUALITY ASSURANCE STANDARDS

A. The entire VFD system as described herein shall be assembled and factory tested to assure a properly coordinated system.
B. Codes: Provide equipment is full accordance with the latest applicable rules, regulations, and standards of:

1. Local Laws and Ordinances.
2. State and Federal Laws.
3. National Electrical Code (NEC).
4. Underwriters Laboratories (UL).
5. American National Standards Institute (ANSI).
6. National Electrical Manufactures Association (NEMA).
7. Institute of Electrical and Electronic Engineers (IEEE).

C. The complete drive system shall be UL listed.
D. The manufacturer will have a minimum of 12 years experience in Integrated Bi-polar Transistor technology.

1.3 ACCEPTABLE EQUIPMENT MANUFACTURERS

A. SCHNEIDER ALTIVAR 630

1.4 SUBMITTALS

A. Submittals shall conform in all respect to this section.
B. Submittals shall be prepared specifically for this project by the VFD manufacturer. For this specific application submittal package will be due three weeks upon request.
C. Submittal information shall include, but not be limited to:

1. Equipment dimensions, including stub-up locations, shipping split and shipping weights.
2. Approval electrical drawings, termination drawings and component location diagrams.
3. Manufactures equipment specification.
4. Catalog cut sheets of major components.
5. Spare parts list, per Paragraph 3.03.
6. Certifications, including:

    a. Warranty, per section 1.04
    b. Efficiencies, per section 2.02. A.1.
    c. Harmonic distortion analysis study, per section 2.01E.

1.5 WARRANTY

A. All equipment furnished under this section shall be warranted for all parts and labor by the CONTRACTOR and the original equipment manufacturer for a period of not less than one (1) year from the date of startup.
B. The manufacturer shall meet the quality and program requirements of ISO 9001.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Any modification to the standard product required to meet this specification shall be performed by the VFD manufacturer or approved systems integrator only. Distributors and panel manufactures changes to the VFD products are specifically disallowed.

B. The VFD system shall consist of harmonic filter unit, input rectifier-grade phase shifting transformer (18 pulse drives only), 6 pulse converter section, output inverter and control logic. All components shall be wired and tested together as a complete system. The labor and materials for field interconnection of the system are to be provided by the VFD manufacturer. Each drive shall be designed for stand alone operation. Multiple drive units shall not utilize shared components. The drive shall be housed in a free standing, front accessible, general purpose indoor enclosure rated NEMA 1, gasketed, with fans and filters. Cabinets shall be single or multi-bay, sheet steel with hinged doors. Doors will have concealed hinges with lockable through-the-door handle operator mechanism. Provisions shall be made for top or bottom entry/exit of incoming line power cables, outgoing load cables and control wiring. All VFD's shall include DC link reactors.

C. Each VFD shall have a molded case, circuit breaker type main power disconnect switch, with an external operating handle. The circuit breaker and the drive unit shall have a minimum short circuit rating of 42,000 amperes RMS symmetrical interrupting capacity and shall be labeled in accordance with UL Standard 489.

D. The following safety features shall be standard on all drives:

1. Provisions to padlock main disconnect handle in the "OFF" position.
2. Mechanical interlock to prevent opening cabinet door with disconnects in the "ON" position, or moving disconnect to the "ON" position while the unit door is open.
3. Auxiliary contact on main disconnects to isolate control when fed from external source.
4. Barriers and warning signs on terminals that are energized with the power disconnect "OFF".

E. Any VFD over 10 horsepower shall meet all requirements as outlined in the latest adopted edition of IEEE 519 for each individual and total harmonic voltage and current distortion and as indicated in this specification. As per Table 10.2 of latest adopted IEEE 519, individual or simultaneous operation of the VFD's shall not add more than 3% total voltage harmonic distortion while operating at full load and speed from the utility source, or more than 5% while operating from a standby generator (if applicable).

1. The VFD manufacturer cannot predict or be responsible for pre-existing voltage distortion on the line or distribution from sources supplied by others. Maximum input voltage unbalance shall be .5% as defined in NEMA MG1 section 14.35.2.
2. As per Table 10.3 of latest adopted IEEE 519, maximum allowable total harmonic current demand distortion limits for each VFD operation at full load and speed shall not exceed 5% as calculated and measured at the point of common coupling Isc/II>20).
3. The point of common coupling for all harmonic calculation and field measurement for both voltage and current distortion shall be defined as the main bus feeding each drive.
4. The short circuit current used for harmonic calculations shall be defined as the total full load current with all VFD's operating multiplied by twenty. Example (5) 100 HP VFD's Full load current = 5 x 126 amps = 630 amps. Short circuit current = 20x 630 amps = 12600 amps.

5. If harmonic filters are required to meet these requirements, the VFD manufacturer must provide as a minimum 5th, 7th, and 11th harmonics filters and is responsible for the design and manufacturing of the filters. The vendor must supply cabling and installation for the filters. The filters are to be provided with a separate contactor such that the VFD can operate in the event of a filter failure. Failure of a filter shall not cause the entire drive system to shutdown.

F. Harmonic compliance shall be verified with onsite field measurement of both the voltage and current harmonic distortion on the main bus of the VFD termination without the VFD in operation. A recording of harmonic analysis displaying individual and total harmonic currents and voltage must be utilized.
G. VFD system shall maintain a 95 minimum true power factor throughout the entire speed range.
H. Displacement power factor shall be .95 percent or higher throughout the entire operating speed range, measured at drive input terminals.
I. For motors 400hp and above, the drive shall include an RTD monitoring module which shall monitor 8 – 100 ohm platinum RTD's in the motor.
J. Variable Frequency Drive Ratings:

1. The minimum drive efficiency for NEMA 1 enclosed drive shall be 95.0 percent or better at motor base speed and rated torque. Losses shall include all control power and cooling system losses associated with the drive as well as the input phase shifting transformer.
2. Input Power rating shall be 400-460VAC, plus 10 percent, minus 10 percent, 3 phase, 60 Hz, plus 2, minus 2 Hertz.
3. The voltage ride through of the VFD shall be capable of sustaining continued operation with a 40% dip in normal line voltage. Output speed may decline only if current limit rating of VFD is exceeded.
4. Power loss ride through of the VFD shall be capable of a minimum of 3 cycles loss.
5. The output power shall be HP, 460 Volt, 3 Phase, 60 Hertz, per motor nameplate FLA at installed altitude plus service factor of 25%.
6. The operating ambient Temperature -10 to 40°C (14 to 104°F).
7. The storage temperature shall be -20 to 60°C (4 to 140°F).
8. The relative operating humidity shall be 0 to 95% Non-Condensing.
9. The site operating vibration condition shall be acceleration at 0.6 G maximum (10-55 Hz). Amplitude at 0.1mm maximum (50-100 Hz).
10. Drives shall be sized/de-rated to operate at full load at an elevation of 5000 ft.
11. Power unit rating bases shall be 100% rated current continuous and 120% for one minute at rated temperature.

2.2 CONSTRUCTION

A. The controller shall produce an adjustable AC voltage / frequency output. It shall have an output voltage regulation to maintain correct output V/Hz ratio despite incoming voltage variations.
B. The controller shall have a continuous output current rating of 100% of the motor nameplate rating as a minimum.
C. The converter section will incorporate three distinct diode bridges configured in a series connection. The series connection will provide continued balance of the bridges to insure the harmonic litigation remains consistent throughout the life of the drive. The input to the diode bridges will be a full phase shifting isolation transformer with multiple secondaries. The variable frequency drive system shall also include a filter network and a transistorized inverter section. The drive manufacturer will also manufacture the Transistors used in the inverter section of the drive to reduce harmonics to flow back to the incoming power source.
D. The inverter output shall be generated by to be Insulated Gate Bipolar Transistors (IGBT's) with a PIV rating of 1200 volts minimum. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor lines current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for a pure sin wave operation.
E. The controller (s) shall be suitable for operating standard NEMA Design-B induction squirrel-cage motor having a 1.15 service factor. The drive can be located up to 300 feet from the motor without requiring special cabling or a separate motor protection devices. Motor nameplate information shall be provided by the CONTRACTOR, prior to contract award to the VFD manufacture to properly size the inverter. In the future, is shall be possible to substitute any standard inverter rate motor (equivalent house power, voltage and RPM) in the field. Output filters shall be installed for motors over 300 foot from VFD.
F. The control logic section shall be fully digital and not require analog adjustment pots or fixed selector resistors. A power failure will not necessitate a reload of any drive parameter or configuration.

2.3 BASIC FEATURES

A. The door of each adjustable speed drive system shall include an operator interface station and key pad with a manual speed device. The interface shall be LED and have a minimum of 4 – digit, 7 – segment display. Each drive shall have a "Local", "Remote", "Manual" / "Auto", "Power On", "VFD Running" & "VFD Fault" indicating light or LED signal display. Included in the operator interface shall be a manual start, shop, bypass and fault reset button on the key pad or face of the panel.

B. The VFD shall include a customer selectable automatic restart feature. When enabled the control pad of the VFD it shall automatically attempt to auto restart after a trip condition resulting from over current, over voltage, over load, loss of utility power or out of saturation. It shall be programmable with up to 10 retrys. For safety the drive will require manual restart for other customer programmable faults. The fault displays shall include over current, over voltage, heat sink overheat, load side short circuit, load-side ground fault, inverter overload, stator over-current during start-up, load-side over current during start-up, EEPROM error, RAM error, ROM error, communication error, (Dynamic braking resistor over current), Emergency Stop, Under voltage, low current, over torque, lose of phase, and motor overload.
C. The door mounted key pad interface shall be capable of controlling the VFD and setting the drive parameters. The key pad shall have the following programming features:

1. The digital display must present all diagnostic messages and parameters values in English engineering units when accessed.
2. The digital interface keypad shall allow the operator to enter exact numerical settings in engineering units. A plain English user menu (rather than codes) shall be provided in software in nonvolatile memory as a guide to parameter setting and reset table in the field through the key pad. The drive set up parameters must be able to be transferred to new boards to reprogram spare boards.
3. The VFD shall have the capabilities of communicating via communications to the PLC or SCADA system. All status shall be communication to the PLC / SCADA including 3 phase voltage, 3 phase current, speed, status alarms, errors, etc.
4. Three programmable output relay contacts shall be rated for 250 VAC, 2 Amps. A separate 24 VDC power supply (50 mA) shall be available for control exterior control devices. Two programmable analog output signals shall be available to meet system requirements.
5. The principle output frequency shall be programmable from 0-400 Hz and acceleration / deceleration from .1 to 6000 seconds. The PWM carrier frequency shall be adjustable from .5 to 15 kHz and shall be self adjusting.
6. The VFD shall have internal to the drive a proportional gain; integral gain anti-hunting gain, lag time constant and PID error limit adjustments. This shall be programmable through the key pad.

2.4 ENCLOSURE

A. All VFD components shall be factory mounted and wired on a dead front, grounded indoor NEMA Type 1, gasketed enclosure. It shall be suitable for mounting on a concrete house keeping pad. The steel enclosure shall have a minimum of two-layer of primer and one-layer of industrial finished Sherwin Williams Precision enamel paint.
B. A forced air cooling system will automatically start and stop as necessary to extend the life of the fan.
C. VFD systems shall be stand alone system with an integral through the door mounted disconnect switch operator.

2.5 PROTECTIVE FEATURES AND CIRCUITS

A. The VFD shall have the following additional protective features that will protect against damage to the motor, load conductor, contactors or solid state soft starts and the VFD internal devices and electronics.
B. Three phase short circuit on the VFD output terminals.
C. Losses of input power due to opening VFD input disconnect device or loss of utility power during VFD operation.
D. A loss of one (1) phase of the input power shall cause the drive to trip off protecting the drive systems electronics.
E. The VFD will run without connection to the motor load.
F. The VFD shall sense an output short circuit that may occur during operation.
G. The key pad display shall provide a minimum of the last 50 system faults.
H. There shall be stall protection on an overload condition with inverse time overcurrent trip. Current limits shall be adjustable from 10 to 215% of the drive current.

2.6 PARAMETER SETTINGS

A. The following system configuring setting shall be provided and field adjustable, without exception, through the keypad/display unit. Except for motor nameplate data, all parameters must be adjustable while the processor is on-line and the drive is running.

1. Motor Nameplate Data.
2. Motor Full Load Amps.
3. Motor Frequency.
4. Number of poles.
5. Full Load RPM's.
6. Motor Voltage.
7. Operating current limits. – Min/Max.
8. VFD Configuration Parameters.
9. Independent accel/decel rates.
10. Min./Max. speed (Frequency
11. Forward or Reverse operation.
12. Catch a spinning load selection.
13. Preset Speed capabilities.
14. Volts per Hertz ratio.
15. No load / Full Load boost.

16. Over current trip selection.
17. Frequency jump selection.
18. Programmable meter output signals (Hz. Speed, RPM, Voltage, Torque, PID feed back, input/output power, and DC bus voltage.

B. Automatic Control

1. 4-20 mA input control signal.
2. PID internal or external set point capabilities.
3. Programmable preset speed operational run conditions.
4. Automatic load reduction during overload condition or soft stall.
5. Programmable loss of signal control: Stop, maintain speed or default to preset speed or set point.

C. All drive setting adjustable and operation parameters shall be restored in a parameter log which allows minimum and maximum points as well as the present set values. This parameter log shall be accessible via a RS-232 or RS485 serial port as well on the keypad or internal to the drive.

D. The drive shall have the following inputs/output features that will provide control and monitoring of the VFD. The analog outputs shall be isolated as required by this specification.

1. Three programmable analog outputs.
2. Two programmable analog inputs. The 4-20mA analog input speed reference signal will be galvanically isolated. Calibration adjustments shall be provided by the keypad.
3. 4-groups of 8 pattern runs or 32 pattern runs shall be available.
4. Three programmable digital output (form C, dry contact relays)
5. One potential pot input (three wire control) +10 V, wiper and common.
6. System control program providing built–in drive control or application specific configuration capabilities.
7. One system E-stop input (dry contact) cost to stop.
8. Input / output function shall match those indicated in the drawings.
9. Minimum / maximum dry contact output.

2.7 DIAGNOSTIC FEATURES AND FAULT HANDLING

A. The VFD shall include a comprehensive microprocessor based digital diagnostic system that monitors its own control functions and displays faults and operating conditions.

B. A “Fault Log” shall be accessible through the keypad digital illustrations in English. The display shall be capable of illustrating 50 past faults. Optional output shall be through the serial port link. All drive possible fault conditions will be accessible through the fault log.

2.8 DRIVE OPTIONS

A. For drives located more then 300 feet from motor, the drive shall be modified to include a factory or SI wired output line reactor.
B. Information included elsewhere:
    1. Drive feed location – See Drawings.
    2. Drive overall dimensions allowed – See Drawings.
    3. Additional control information – See Drawings.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. The drives will be completely assembled, wired, and tested in the United States of America. The following tests will be performed:
    1. The manufacturer shall use the ISO-9001 standards in the purchase, engineering, manufacturing and testing of the VFD system.
    2. Upon completion of manufacture and assembly, the drives shall be subjected to a complete factory test to demonstrate compliance with specified features and characteristics of the specification. The purchaser at his option shall be able to witness factory testing of his unit, with factory coordination.
    3. The testing procedure shall be the manufacturer's standard procedure (except for loss of phase) to assure maintenance free service. The buyer shall be given a 5 day notice prior to the start of factory testing for the buyer's representative to witness the testing.
    4. All equipment, devices, instrumentation, and personnel required to perform the factory tests shall be supplied by the manufacturer. Upon satisfactory completion of the test, the seller shall upon request submit two (2) certified copies of the test report to the buyer. Component failure during testing will require repeating any test associated with the failure or modified components to demonstrate proper operation.
    5. A loss of each phase testing shall be conducted at the factory to guaranty the safe and orderly shutdown of the drive under load. These tests shall conclude that the drive will not fail its electronic circuits or causes sever over heating of the bridges. These tests shall not limit the life of the drive system. There are no exceptions to this test. This test shall be performed and test reports provided to the ENGINEER prior to installation of the drive system package.

3.2 STARTUP AND FIELD TESTING

A. The VFD manufacturer shall provide the services of a factory trained technician for startup assistance, programming and testing. Verification of the VFD input harmonics voltage and current distortion limits specified must be verified as part of the start-up and acceptance. If harmonics distortion requirements are not met, it is the responsibility of the VFD supplier to meet these specifications at the manufacturer's expense. Meg-ohm testing will be done to the load conductors and motor to verify condition of the equipment prior to startup. The VFD manufactures shall certify the VFD and motor system as compatible. UL508 technicians shall not be allowed to perform startup procedures.
B. A 10% payment retention will be released upon factory field test verification of harmonic specifications requirements and final test report and acceptance.
C. Spare Parts

    1. The following spare parts shall be furnished. The net price per item shall be provided with the request for proposal. Each spare part shall be package and identified by part number and type for long term customer storage.

        a. Three of each type of fuse rated 480 Volts or less.
        b. Two of each type of converter power semi-conductor.
        c. Two of each type of inverter power semi-conductor.
        d. One of each type of control board, gate firing board and communication board.
        e. One key pad assembly.
        f. Five of each type of panel lamp.
        g. Three of each size MOV's.

END OF SECTION

SECTION 26 32 00
STANDBY ENGINE GENERATOR

PART 1 - GENERAL

1.1 DESCRIPTION OF SYSTEM

A. Provide a standby power system to supply electrical power in event of failure of normal supply, consisting of a liquid cooled engine, an AC alternator, system controls, and sound attenuated enclosure with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter.
B. Provide an automatic transfer switch, specified elsewhere, as part of a packaged system such that the system comes on-line fully automatically, and on restoration of utility power automatically retransfers load to normal power, shuts down the generator and returns to readiness for another operating cycle.

1.2 REQUIREMENTS OF REGULATORY AGENCIES

A. Conform to N.E.C. and applicable inspection authorities.
B. Transfer switch(s) to be labeled under UL 1008 and shall be programmed by a factory trained and authorized representative.

1.3 MANUFACTURER QUALIFICATIONS

A. These systems shall be supplied by a manufacturer who has been regularly engaged in the production of engine-alternator sets, automatic transfer switches, and associated controls for a minimum of fifteen years, thereby identifying one source of supply and responsibility.
B. To be classified as a manufacturer, the builder of the generator set must manufacture at minimum engines or alternators.
C. The manufacturer shall have printed literature and brochures describing the standard series specified, not a one of a kind fabrication.
D. Manufacturers:

1. Caterpillar
2. Cummins
3. Kohler
4. Generac

E. Substitutes: Proposed substitutions shall include complete submittal data, as specified herein and required elsewhere, clearly denoting and all deviations and/or exceptions to the equipment specified. The complete proposed substitution must be submitted in accordance with the Standard General Conditions and Supplementary Conditions.

1.4 WARRANTY

A. The standby electric generating system components, complete engine-generator and instrumentation panel shall be warranted by the manufacturer against defective materials and factory workmanship for a period of 36 months or 3,000 hours, whichever is greater. This warrantee shall include freight, shipping, labor, parts, etc. for the entire generation system. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for travel and labor. An additional 4 years of the manufacturer's standard warranty coverage shall be provided. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

1.5 SUBMITTALS

A. Provide complete sets of Engineering Submittal for approval, prior to production release, showing all components, in addition to the engine and generator. Submittals shall show compliance with these specifications.
B. Provide sizing calculations showing the submitted units ratings at altitude and ambient temperature.
C. Refer to Sections 01 30 00 and 26 05 00 for additional submittal requirements.

PART 2 - PRODUCTS

2.1 ENGINE

A. The prime mover shall be a liquid cooled, diesel fueled, turbo charged, after cooled engine of 4-cycle design. The unit requires a minimum rated output as specified in these documents at an operating speed of 1800 RPM.
B. The engine is to be cooled with a unit mounted radiator, fan, water pump, and closed coolant recovery system providing visual diagnostic means to determine if the system is operating with a normal engine coolant level. The radiator shall be designed for operation in the ambient temperature conditions listed in this document. Fan and radiator shall be sized for the critical grade sound attenuated enclosure of the generator.

C. The intake air filter with replaceable element must be mounted on the unit. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter with internal bypass and replaceable elements. Engine coolant and oil drain extension must be provided to outside of the mounting base for cleaner and more convenient engine servicing. A fan guard must be installed for personnel safety.
D. The engine shall have a battery charging DC alternator with a transistorized voltage regulator. Remote 2-wire starting shall be by a solenoid shift, electric starter.
E. Engine speed shall be governed by electronic governor to maintain alternator frequency within .5% from no load to full load alternator output. Steady state regulation is to be 0.25%.
F. The engine fuel system shall be designed for operation with Diesel fuel. A fuel shutoff solenoid and all fuel lines must be installed at the point of manufacture.
G. Sensing elements to be located on the engine for low oil pressure shutdown, high coolant temperature shutdown, low coolant level shutdown, overspeed shutdown and overcrank protection. These sensors are to be connected to the control panel using a wiring harness with the following features: wire number labeling on each end of the wire run for easy identification, a molded rubber boot to cover the electrical connection on each sensor to prevent corrosion and all wiring to be run in flexible conduit for protection from the environment and any moving objects.
H. Engine Manufacturers:

1. Caterpillar
2. Cummins
3. John Deere
4. GM
5. Perkins
6. Volvo
7. Generac
8. Detroit Diesel

2.2 CAPABILITY REQUIREMENTS

A. Generators shall have the following operation capabilities:

Generator No. 1

Site Rated kW rating	250 kW @ 0.8 Power Factor . Confirm with drawings.
Fuel -	Diesel
Voltage-	480/277, Parallel Wye
Phase -	Three (3)

Frequency (Hz)	60
Altitude -	4700 feet
Ambient Temperature	-30 degrees F to 110 degrees F.

Main Breaker, Solid State with GFP, 100% Rated – Sizes as indicated on the drawings.

2.3 FACTORY INSTALLED EQUIPMENT

A. Generator Set(s) shall have solid state controller(s) as standard. Controls shall be factory installed and tested. Controllers shall be reliable, durable and accurate, have easy to read meters. Three spare inputs and one spare output shall be provided for customer programmed set points. Controller shall use an SAE format, the panel shall zero in on the affected system and identify the component responsible for the failure. Key-pad programmable set points, following items shall be standard features of controller:

1. Digital (LCD) Indication
    a. AC Voltage (L-L)
    b. AC amps
    c. System Diagnostics
    d. Frequency
    e. DC Voltage
    f. Coolant Temperature
    g. Oil Pressure
    h. RPM
    i. Hours Run
2. Controls
    a. Auto Start/Stop
    b. Emergency Stop
    c. Lamp Test
    d. Cycle Crank
    e. Voltage Control
    f. Cooldown Timer
    g. Phase Selector Switch
3. Indicating Lights
    a. Low Oil Pressure
    b. High Coolant Temperature
    c. Overspeed
    d. Overcrank

e. Emergency Stop
f. Fault Shutdown *
g. Fault Alarm *
h. Not in auto
i. Pre-Alarm

1) 1 Spare Inputs – Customer Programmable

B. A heavy duty, lead acid battery set shall be provided by the generator set manufacturer of adequate voltage and amperage capacity to start and operate the engine. Provide all intercell and connecting battery cables as required.
C. The manufacturer shall supply and install its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system.
D. The engine shall have a unit mounted, thermostatically controlled water jacket heater to aid in quick starting. It will be of adequate wattage as recommended by the engine manufacturer. The contractor shall provide proper branch circuit from normal utility power source.
E. An oil heater and thermostat shall be installed in the engine oil pan at the factory as recommended by manufacturer.
F. A block heater and thermostat shall be installed in the engine block at the factory as recommended by manufacturer.
G. Provide a thermostatically controlled blanket type battery heater to increase engine battery capacity for cold weather starting.
H. Provide an automatic dual rate battery charger manufactured by the engine-generator set supplier. The automatic equalizer system shall monitor and limit the charge current to 10 amps. The output voltage is to be determined by the charge current rate. The charger must have a maximum open circuit voltage of 35 volts and be protected against a reverse polarity connection. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.

2.4 THE FOLLOWING EQUIPMENT IS TO BE PROVIDED BY THE ENGINE-GENERATOR SET MANUFACTURER AND SHIPPED LOOSE WITH THE UNIT:

A. The manufacturer will supply its recommended flexible fuel line to connect the engine to the external fuel source. On stationary applications the fuel line shall match the fuel fitting on the unit base rail and have braided stainless steel covering with brass fittings.
B. Installation acceptance test to be conducted on-site shall include a “cold start” test, a six-hour full load test, and a on-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank for 100% rated load and make temporary connections for full load test.

2.5 ALTERNATOR

A. The alternator shall be a 4-pole revolving field type, 12 lead, wired for or 277/480 VAC, three phase, 60 Hz with a brushless, PMG exciter. Photosensitive components will not be permitted in the rotating exciter. The stator shall be direct connected to the engine to insure permanent alignment. The generator shall meet temperature rise standards for Class "H" insulation; operate within Class "F" standards for extended life. All leads must be extended into an AC connection panel. The alternator shall be protected by internal thermal overload protection and an automatic reset field circuit breaker.

B. One step load acceptance shall be 100% of nameplate rating and meet the requirements of NFPA 110 paragraph 5-13.2.6. The generator set and regulator must sustain at least 90% of rated voltage for 10 seconds with 250% of rated load at near zero power factor connected to its terminals when equipped with direct or brushless excitation. 300% short circuit current must be selectable on units equipped with permanent magnet exciters. Generators equipped with permanent magnet exciters not allowing the selection of the short circuit current ratings are not allowed.

C. A solid state voltage regulator designed and built by the engine-generator set manufacturer must be used to control output voltage by varying the exciter magnetic field to provide + or - 1% regulation during stable load conditions. Should an extremely heavy load drop the output frequency, the regulator shall have a voltage droop of 4 Volts/Hertz to maximize motor starting capability. The frequency at which this droop operation begins must be adjustable, allowing the generator set to be properly matched to the load characteristics insuring optimum system performance. Additional rheostats for matching generator voltage, droop, and stability characteristics to the specific load conditions must be available.

D. The voltage regulator must contain a limiting circuit to prevent output voltage surges in excess of 125% of rated voltage during generator set operation. On loss or near loss of the voltage sensing signal, the voltage regulator must be capable of shutting down to prevent an overvoltage condition from occurring. It must have a second mode of operation allowing 300% of rated current to flow through the electrical distribution circuit(s) for ten (10) seconds under the same conditions. Voltage regulators not capable of selecting either mode of operation are not acceptable. LED indication will be provided on the regulator to monitor the sensing (yellow), excitation (green), and output circuit (red).

E. A NEMA 1 panel that is an integral part of the generator set must be provided to allow the installer a convenient location in which to make electrical output connections. An isolated neutral lug must be included by the generator set manufacturer to insure proper sizing.

2.6 MOUNTING

A. The electric plant shall be mounted with vibration isolators on a welded steel base that shall permit suitable mounting to any level surface.

2.7 PROVIDE FOLLOWING ITEMS INSTALLED AT FACTORY

A. The unit mounted main line circuit breaker shall have an internal set of form "C" contacts that change state whenever the breaker is opened or closed. Lamps on the generator control panel shall indicate breaker position and screw terminals in the control panel shall provide appropriate system DC voltage for remote annunciation.
B. A solid state, thermal magnetic UL listed main line circuit breaker shall be mounted in the AC connection panel. The line side connections are to be made at the factory. A system utilizing a manual reset field circuit breaker and current transformers is unacceptable.

2.8 CONTROLS

A. All engine alternator controls and instrumentation shall be designed, built, wired, tested and shock mounted in a NEMA 12 enclosure to the engine-generator set by the manufacturer. It shall contain panel lighting, a fused DC circuit to protect the controls and a +/-5% voltage adjusting control. This panel must be able to be rotated 90 degrees in either direction for correct installation.
B. The engine-generator set shall contain a complete 2 wire automatic engine start-stop control which starts the engine on closing contacts and stop the engine on opening contacts. A cyclic cranking limiter shall be provided to open the starting circuit after eight attempts if the engine has not started within that time. Engine control modules must be solid state plug-in type for high reliability and easy service. The engine controls shall also include a 3-position selector switch with the following positions: AUTO/OFF/RUN. Auto will allow full automatic operation, off disables any engine start, run starts the engine. An emergency stop switch, panel fuse, 5% voltage adjust rheostat and RS485/Ethernet communications port shall be panel mounted.
C. A micro-processor based digital control panel will be supplied. It shall simultaneously display all operating conditions including:

    1. AC Volts
    2. AC Amperes
    3. Frequency
    4. Power Factor
    5. KW Output
    6. Oil Pressure
    7. Water Temperature
    8. Fuel level
    9. Battery Voltage
    10. Run Time Hours. It shall have individual LED's to indicate:

        a. Selected Phase
        b. High or Low AC Voltage

c. High or Low Battery Voltage
d. High or Low Frequency
e. Low and Pre-Low Oil Pressure
f. Low Water level
g. Low Water Temperature
h. High and Pre-High Engine Temperature
i. High, Low and Critically Low Fuel Levels and Fuel in Rupture Basin
j. Emergency Stop
k. Overcrank
l. Overspeed
m. Unit not in Automatic Mode
n. Status of Main Line Circuit Breaker(where applicable)
o. Program Mode

11. Two additional LED's for future programming. A keypad shall allow local programming of the units operating parameters as well as testing and resetting of the alarm LED's. The keypad shall include the phase selector function.

D. The following equipment is to be installed at the engine-generator set manufacturer's facility:

1. A red mushroom type emergency stop switch shall be mounted on the generator control panel and when pressed shall shutdown the engine/generator requiring a manual reset before operation can resume.
2. A sensor shall be installed in the sub-base fuel tank indicating 50% of fuel remaining (where applicable). A "Low Fuel" lamp on the control panel and on the remote annunciator will illuminate when this level is reached. The alarm shall be available to the Alarm System.

2.9 UNIT ACCESSORIES

A. Generator set housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. The housing shall have hinged side-access doors an rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer’s standard color using a two step electrocoating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:

1. Primer Thickness, 0.5-2.0 mils
2. Top Coat Thickness, .08-1.2 mils
3. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall not exceed 50%

4. Crosshatch Adhesion, per ASTM D3359-93, 4B-5B
5. Impact Resistance, per ASTM D2794-93, 120-160 inch pounds
6. Salt Spray, per ASTM B117-90, 1000+ hours
7. Humidity, per ASTM D2247-92, 1000+ hours
8. Water Soak, per ASTM D2247-92, 1000+ hours

B. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work.

C. The generator set shall be provided with sound-attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 72 dB(A) 7 meters from the nearest point of the proposed generator installation location and 60dB minimum at the edge of the nearest residential lot. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant. No foam materials shall be used unless they can be demonstrated to have the same durability and life as fiberglass. The engine-generator set shall be factory enclosed in a 12 gauge steel enclosure constructed with corner posts, uprights and headers. The roof shall aid in the runoff of water and include a drip edge. The enclosure shall be coated with electrostatically applied power paint, baked and finished to manufacturer's specifications. The enclosure shall be completely lined with 1" thick minimum, UL 94 HF-1 listed, sound deadening material. This material must be of a self extinguishing design. The enclosure is to have large, hinged, removable doors to allow access to the engine, alternator and control panel. Hinges and all exposed fasteners will be stainless steel. Each door will have lockable hardware with identical keys. Padlocks do not meet this specification. The critical silencer shall be mounted within the enclosure to further reduce the unit sound level and provide a clean, smooth exterior design. The enclosure shall include sound insulated, baffled air intake hoods and air exhaust hoods. The generator set shall be sized to account for losses in sound baffles and critical grade appurtenances.

D. The following equipment is to be provided by the engine-generator set manufacturer:

1. Spring type vibration isolators to mount between the engine mounting base and fuel tank frame to eliminate noise, reduce transmitted vibration and provide earthquake protection.

E. Provide a dual wall sub base fuel tank with day tank fuel level controls.

1. The sub base fuel tank will contain 48 hours of diesel fuel to support the generator set for a period of 48 hours at full load. The sub base fuel tank shall be listed under UL 142, sub section entitled "Special Purpose Tanks EFVT" category, and will bear their mark of "UL Approval" according to their particular classification.
2. Secondary Containment Generator Base Tank:

a. Aboveground steel secondary containment rectangular tank for use as a sub base for diesel generators intended to be installed in accordance with the standards of NFPA 30, 37 & 110. These tanks have provisions for monitoring the annular (containment) space for leakage. (Both the inner and outer containment tanks must provide for emergency venting per NFPA 30.).
b. Rectangular, heavy gauge, welded steel construction.
c. Double wall with a sealed, separately vented, integral fuel containment basin.
d. Reinforced steel box channels for generator support.
e. Full height gussets provided at genset mounting holes.
f. Interior coated with a solvent-based rust inhibitor.
g. Top-mounted fuel gauge.
h. Engine fuel supply and return drop tubes.
i. Day tank supply and return drop tubes.
j. Raised fuel fill.
k. Mounting brackets for optional pump and control.
l. Ground clearance to minimize bottom rusting.
m. Integral lifting points.
n. Tanks are leak-checked to ensure integrity of weld seams prior to shipment.

3. Ancillary Equipment:

   a. The base tank will be equipped with accessories required for the application and by NFPA 30 for this application. The accessories shall include but not be limited to:

      1) Low fuel level float switch, set at 10% level.
      2) High fuel level / overfill prevention, audible alarm, set at 90% level.
      3) Overfill prevention float valve or solenoid on tank fill port, set at 95% level.
      4) Fill port drop tube to within 6” of the bottom of the tank.
      5) Spill containment bucket or basin around fill port.
      6) Interstitial monitoring float switch (leak detection).
      7) Normal vents, extended 12 feet above grade, flame arrester caps.
      8) Emergency vents, on tank and containment basin.
      9) Provisions for connection of grounding conductor.
      10) Tank calibration chart in inches to gallons.
      11) Warning Signage; No Smoking, Flammable Liquids, Diesel Fuel, NFPA 704 Placards. Fuel level transmitter

4. The tank shall include independent level sensors and remote dry contacts for a critical high fuel shutdown. The alarm condition activates a red light on tank control panel, coils on a relay for remote annunciation and closes a normally open solenoid valve in the fuel inlet piping.

5. All alarms and level controls shall be factory assembled and wired so that only a 115 VAC power supply need be applied to make the tank control system functional. The remote alarm dry contacts will require separate wiring and power supply.

6. A fuel strainer shall be provided and installed up stream of all solenoid valves in the fuel inlet piping.

PART 3 - EXECUTION

3.1 FACTORY TESTING

A. Before shipment of the equipment, the engine-generator set shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Tests shall include:

1. Verifying all safety shutdowns are functioning properly.
2. Single step load pick-up per NFPA 110, Paragraph 5-13.2.6.
3. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.

3.2 OWNER'S MANUALS

A. Three (3) sets of OWNER's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

3.3 INSTALLATION

A. CONTRACTOR shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer's recommendations as reviewed by the ENGINEER.
B. CONTRACTOR to supply all lugs required for external load connections.

3.4 SERVICE

A. Supplier of the electric plant and associated items shall have permanent service facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the OWNER maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Service contracts shall also be available.

3.5 STARTUP AND CHECKOUT

A. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to checkout the completed installation and to perform an initial startup inspection to include:

1. Engine Generator/ATS Testing: See Section 17100 for requirements

a) Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the panelboard. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment. The test voltage shall be 100 volts dc, applied for 30 seconds between each conductor and ground

and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

b) R in megohms = (rated voltage in kV + 1) x 304,800/(length of cable in meters)

c) R in megohms = (rated voltage in kV + 1) x 1000/(length of cable in feet)

d) Each cable failing this test shall be repaired or replaced. The repair cable shall be retested until failures have been eliminated.

2. Circuit breakers and switchgear shall be examined and tested in accordance with the manufacturer's published instructions for functional testing.

B. Inspections

The following inspections shall be performed jointly by the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts.
2. Governor type and features.
3. Engine timing mark.
4. Starting motor.
5. Starting aids.
6. Coolant type and concentration.
7. Radiator drains.
8. Block coolant drains.
9. Coolant fill level.
10. Coolant line connections.
11. Coolant hoses.
12. Combustion air filter.
13. Intake air silencer.
14. Lube oil type.
15. Lube oil sump drain.
16. Lube-oil filter.
17. Lube-oil level indicator.
18. Lube-oil fill level.
19. Lube-oil line connections.
20. Lube-oil lines.
21. Fuel type.
22. Fuel-level. (where applicable)
23. Fuel-line connections.
24. Fuel lines.
25. Fuel filter.
26. Access for maintenance.

27. Voltage regulator.
28. Battery-charger connections.
29. Wiring & terminations.
30. Instrumentation.
31. Hazards to personnel.
32. Base.
33. Nameplates.
34. Paint.
35. Exhaust-heat system.
36. Exhaust muffler.
37. Switchboard.
38. Switchgear.
39. Access provided to controls.
40. Enclosure is weather resistant.
41. Engine & generator mounting bolts (application).

C. Performance Tests

1. In the following tests, where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. For the following tests, if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries, the associated tests shall be repeated.
    1. Continuous Engine Load Run Test:
        Test the engine-generator set and ancillary systems at service load to demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Data taken at 15 minute intervals shall include the following:
        Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.
        Pressure: Lube-oil.
        Temperature: Coolant, Lube-oil, Exhaust, Ambient.
        a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.
        b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warmup period.
        c. Operate the engine generator-set for 2 hours at 75% of Service Load.
        d. Increase load to 100% of Service Load and operate the engine generator-set for 4 hours.

2. Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements.

Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer.

Tabular data shall include the following:

1) Ambient temperature (at 15 minute intervals).
2) Generator output current (before and after load changes).
3) Generator output voltage (before and after load changes).
4) Frequency (before and after load changes).
5) Generator output power (before and after load changes.
6) Graphic representations shall include the actual instrument trace of voltage and frequency showing:

b) Charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.

a. Perform and record engine manufacturer's recommended prestarting checks and inspections.
b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.
c. With the unit at no load, apply the Maximum Step Load Increase.
d. Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.
e. Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100% of Service Load.
f. Apply the Maximum Step Load Increase.
g. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.
h. Repeat steps c. through g.

D. Generator Fail Test:

1. Test the capability of each engine-generator set to pick up the entire load if the alternate generator fails. During operations record load-sharing characteristics of each set in parallel operation. Data taken shall include the following:
   a) Ambient temperature (at 15 minute intervals).
   b) Generator output current (before and after load changes).
   c) Generator output voltage (before and after load changes).
   d) Power division and exchange between generator sets.
   e) Real power (watts) and reactive power (vars) on each set.
2. Combinations
   a) Connect each set, to the load of the system, operating at service load, until all possible two-unit-in-parallel combinations have been achieved.

Verify stabilization of voltage and frequency within specified bandwidths and proportional sharing of real and reactive loads. Document stabilization of voltage and frequency within specified bandwidth, and voltage and frequency stability and transient response in the following steps for each combination.

E. Automatic Operation Tests for Engine Generator Set:
   1. The automatic operating system shall be tested to demonstrate automatic starting, the response to loss of operating engine-generator sets, and paralleling of each engine-generator set. The loads for this test shall utilize actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:
      a) Ambient temperature (at 15 minute intervals).
      b) Generator output current (before and after load changes).
      c) Generator output voltage (before and after load changes).
      d) Generator output frequency (before and after load changes).
      e) Power of each generator set.
      f) Real and reactive power on each set.
   2. Initiate loss of the preferred power source and verify the specified sequence of operation.
   3. Verify resetting of automatic starting and transfer logic.

F. Automatic Operation Tests for Stand-Alone Operation
   1. The automatic loading system shall be tested to demonstrate automatic starting, of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:
      a) Ambient temperature (at 15 minute intervals).
      b) Generator output current (before and after load changes).
      c) Generator output voltage (before and after load changes).
      d) Generator output frequency (before and after load changes).
         1) Initiate loss of the primary power source and verify automatic sequence of operation.
         2) Restore the primary power source and verify sequence of operation.
         3) Verify resetting of controls to normal.

G. Pull the Plug System Test:
   1. The contractor shall record all voltages and frequencies prior to and after each sequence of the test.
   2. Contractor shall simulate a power outage by opening all circuit breakers which feed automatic transfer switches. The contractor shall then observe that the engines generators start up and run and that the transfer switches take the load. Time delays for start up and transfers of each transfer switch shall be recorded. The contractor shall verify proper operation of each automatic transfer switch.

   3. Contractor shall verify proper startup and operation of all equipment including

fans, pumps, chillers, alarm and monitoring systems and lighting systems.

4. Contractor shall verify proper operation of lighting systems to insure that emergency lighting has returned. Contractor shall verify the proper operation of each fan coil unit.
5. The contractor shall verify proper operation of each UPS to insure that power to critical loads was not interrupted.
6. The contractor shall then restore power to transfer switches by closing each of these breakers and verifying that all systems time out and retransfer, that generators cool down and subsequently shut off. All time delays shall be recorded.
7. Contractor shall then verify proper restart of all equipment as noted above.
8. Contractor shall then verify that each UPS maintained power to the critical load during the retransfer.
9. Contractor shall then verify that all lighting and non UPS systems return to normal operation.

END OF SECTION

SECTION 263553
SURGE PROTECTION DEVICES

PART 1 – GENERAL

1.01 SCOPE

The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

1.02 RELATED SECTIONS

1. Section 262413 "Switchboards" for integral SPDs installed by switchboard manufacturer.
2. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.
3. Section 262726 "Wiring Devices" for integral SPDs installed by receptacle manufacturer.

1.03 REFERENCES

4. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards

   A. ANSI/UL 1449 4th Edition or later
   B. ANSI/UL 1283 5th Edition or later (type 2 applications)
   C. IEEE C62.41.1
   D. IEEE C62.41.2
   E. IEEE C62.43-2005
   F. IEEE C62.45-2002
   G. IEEE C62.48-2005
   H. IEEE C62.62-2010
   I. UL 96A
   J. NFPA 780

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

5. The following information shall be submitted to the Engineer:

A. Provide verification that the SPD complies with the required ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL). Compliance may be in the form of a file number that can be verified on UL's website www.ul.org, the website should contain the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (In).

6. Where applicable the following additional information shall be submitted to the engineer:

   A. Descriptive bulletins
   B. Product sheets

1.05 SUBMITTALS – FOR CONSTRUCTION

7. The following information shall be submitted for record purposes:

   A. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process

1.06 QUALIFICATIONS

8. The manufacturer of the electrical distribution equipment shall be the manufacturer of the SPD within the electrical distribution equipment.
9. For the equipment specified herein, the manufacturer shall be ISO 14001 and ISO 9001 or 9002 certified.
10. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
11. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU and have a visible label showing compliance.
12. The SPD shall be UL 1449 current edition listed, 20 kA nominal discharge current, Type 1 or Type 2 for use in UL 96A systems.

1.07 DELIVERY, STORAGE AND HANDLING

Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 – GENERAL

2.01 MANUFACTURERS

1. Eaton or prior approved equal.

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

1. Electrical Requirements

   A. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
   B. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
   C. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.
   D. Unit shall operate without the need for an external overcurrent protection device, and be listed by UL as such. Unit must not require external overcurrent protective device or replaceable internal overcurrent protective devices for the UL Listing.
   E. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

F. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
G. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

2. SPD Design
   A. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
   B. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
   C. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
      a. Type 2 units with filtering shall conform to UL 1283 5th Edition
      b. Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.
   D. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
   E. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
      a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
         i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state

indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.

ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes

iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.

b. Remote Status Monitor (optional) – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

c. Audible Alarm and Silence Button (optional) – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.

d. Surge Counter (optional) – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of 50 ± 20A occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.

i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.

F. Thermal MOV Protection

The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. The use of plug in single-mode

modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

G. Safety Requirements

The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

a. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

2.03 SYSTEM APPLICATION

1. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
2. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

2.04 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

1. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

A. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

B. SPDs shall be installed 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.
C. The panelboard shall be capable of re-energizing upon removal of the SPD.
D. The SPD shall be integral to the panelboard and connected directly to the bus. Alternately, an integral SPD can be connected to a circuit breaker for disconnecting purposes if a disconnect is required.
E. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
F. The SPD shall be of the same manufacturer as the panelboard.
G. The complete panelboard including the SPD shall be UL67 listed.

2.05 SWITCHGEAR, SWITCHBOARD, MCC AND BUSWAY REQUIREMENTS

A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
B. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, or busway
C. The SPD shall be factory installed integral to the switchgear, switchboard, MCC, and/or bus plug at the assembly plant by the original equipment manufacturer
D. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
E. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
F. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
G. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.06 SERVICE ENTRANCE REQUIREMENTS

A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments. EXECUTION.

2.07 EXAMINATION

2.08 FACTORY TESTING

1. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, IEEE, and UL standards.

2.09 INSTALLATION

1. The installation of the SPD shall be factory installed integral to the distribution equipment. The Contractor shall install all distribution equipment per the manufacturer's recommendations, applicable electrical codes and the contract drawings.

2.10 WARRANTY

1. The manufacturer shall provide a ten (10) year warranty (15 year warranty with registration) that covers replacement of the complete unit from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.

END OF SECTION

SECTION 263623
AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

B. Automatic transfer switches

1. Related Sections include the following:

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

1. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
2. Single Line Diagram: Show connections between transfer switch, power sources and load

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

1. Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.
2. Internal electrical wiring and control drawings.
3. Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.

4. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.

C. Manufacturer and Supplier Qualification Data
   1. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
   2. The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. Features and operating sequences, both automatic and manual.
   2. List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.

E. Warranty documents demonstrating compliance with the project's contract requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) at the site within a response period of less than (eight hours or appropriate time period designated for Project) from time of notification.
   1. The transfer switch shall be serviced by technicians employed by, and specially trained and certified by, the generator set supplier and the supplier shall have a service organization that is factory-certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
   2. Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.

3. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

B. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.

C. 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 as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.

D. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
   1. Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.
   2. CSA 282, Emergency Electrical Power Supply for Buildings, and CSA C22.2, No. 14-M91 Industrial Control Equipment
   3. NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.
   4. Comply with NEMA ICS 10-1993 AC Automatic Transfer Switches
   5. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
   6. EN55011, Class B Radiated Emissions and Class B Conducted Emissions
   7. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity
   8. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
   9. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
   10. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
   11. IEC 1000-4-6 Conducted Field Immunity
   12. IEC 1000-4-11 Voltage Dip Immunity
   13. IEEE 62.41, AC Voltage Surge Immunity
   14. IEEE 62.45, AC Voltage Surge Testing

E. Comply with NFPA 99 – Essential Electrical Systems for Healthcare Facilities

F. Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, regardless of the actual circuit level.

G. The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of one (1) year from registered commissioning and start-up, or eighteen (18) months from date of shipment.

H. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:

1. Notify Owner no fewer than 2 days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.
3. Do not energize any new service or distribution equipment without notification and permission of the Owner

1.6 COORDINATION

A. Size and location of concrete bases and anchor bolt inserts shall be coordinated. Concrete, reinforcement and formwork must meet the requirements specified in Division 03. See section "INSTALLATION" for additional information on installation

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASCO 300 Series, DELAYED TRANSITION, SOLID NEUTRAL, 3 PHASE, 400AMP, 480V, NEMA 3R, WITH ACCESSORIES J-3NDTS-A-3-0400-N-GX-F-6DL-11BE-31Z-125A
2. NO SUBSTITUTIONS

B. Equipment specifications for this Project are based on automatic transfer switches manufactured by Cummins Power Generation. Switches manufactured by other

manufacturers that meet the requirement of this specification are acceptable, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.

C. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Provide transfer switches in the number and ratings that are shown on the drawings.

B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.

C. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test. Fault current rating shall be fully rated with breakers protecting switch. Coordinate with panelboard vendor.

D. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches). All switches shall include a center off delay (delayed transition) function to allow for motor loads to slow.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
2. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
3. Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.

4. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.
5. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
6. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.
    a. Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality
7. Transfer switches designated on the drawings as “4-pole” shall have a full current-rated neutral bar with lugs.

H. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism

I. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.

J. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:
1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.
2. Exterior cabinet doors shall provide complete protection for the system’s internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with requirements for Level 1 equipment according to NFPA 110.

B. Indicated current ratings:

1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
2. Main contacts shall be rated for 600 VAC minimum.
3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).

C. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.

D. Transfer switches that are designated on the drawings as 4-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.

E. Automatic Transfer Switch Control Features

1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
3. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 60 seconds.
4. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
5. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

6. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational.
7. Transfer switch shall be equipped with load shed option to drop load if the fire pump starts. See sequence of operation.

F. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.
   1. The indicator panel LEDs shall display:
      a. Which source the load is connected to (Source 1 or Source 2)
      b. Which source or sources are available
      c. When switch is not set for automatic operation, the control is disabled
      d. When the switch is in test/exercise mode
   2. The indicator shall have pushbuttons that allow the operator to activate the following functions:
      a. Activate pre-programmed test sequence
      b. Override programmed delays, and immediately go to the next operation
      c. Reset the control by clearing any faults
      d. Test all of the LEDs by lighting them simultaneously
   3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
      a. AC voltage for all phases, normal and emergency
      b. Source status: connected or not connected.
   4. The display panel shall be password-protected, and allow the operator to view and make adjustments:
      a. Set nominal voltage and frequency for the transfer switch
      b. Adjust voltage and frequency sensor operation set points

c. Set up time clock functions
d. Set up load sequence functions
e. Enable or disable control functions including program transition
f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history

G. Control Functions: Functions managed by the control shall include:
1. Software adjustable time delays:
a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)
d. Engine cooldown: 0 to 30 minutes (default 10 min)
e. Programmed Delayed Transition (Center Off Delay): 0 to 60 seconds (default 3 sec)
2. Undervoltage sensing: three-phase normal, three-phase emergency source.
3. Over-voltage sensing: three-phase normal, three-phase emergency source.
4. Over/under frequency sensing:
a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)
b. Dropout: +/-1% beyond pickup (default 1%)
c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)
d. Accurate to within +/- 0.05 Hz
5. Voltage imbalance sensing:
a. Dropout: 2 to 10% (default 4%)
b. Pickup: 90% of dropout
c. Time delay: 2.0 to 20 seconds (default 5 sec)

6. Phase rotation sensing:
   a. Time delay: 100 msec
7. Loss of single-phase detection:
   a. Time delay: 100 msec

H. Control features shall include:
1. Programmable genset exerciser: A field-programmable control shall periodically start and run the generator with or without transferring the load for a preset time period, then re-transfer and shut down the generator after a preset cool-down period.
2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.
4. Re-Transfer Inhibit Switch: Inhibits automatic re-transfer control so automatic transfer switch will remain connected to emergency power source as long as it is available regardless of condition of normal source.
5. Transfer Inhibit Switch: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of emergency source.

I. Control Interface
1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

J. Engine Starting Contacts
1. One isolated and normally closed pair of contacts rated 10A at 32 VDC minimum.

2.4 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

C. Indicating Lights: Grouped for each transfer switch monitored.

D. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.

E. Switch in test mode.

F. Lamp Test: Push-to-test or lamp-test switch on front panel.

G. Malfunction of annunciator or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation.

H. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation. The remote annunciation system shall not prevent transfer to the alternate source when the primary power source fails, nor prevent return to the primary source if the alternate source fails.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Floor-Mounting Switch: Anchor to floor by bolting.

1. Floor-mounted transfer switches (except drawout switches supported by wheeled carriages, which must be rolled out at floor level) shall be mounted on concrete bases complying with the following requirements:

a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases

according to Division 26 Section "Hangers and Supports for Electrical Systems."

C. Annunciator Panel Mounting: Flush in wall, unless otherwise indicated.

D. Identify components according to Division 26 Section "Identification for Electrical Systems."

E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 SOURCE QUALITY CONTROL

A. Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.

B. Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.

C. Factory shall perform dielectric strength test complying with NEMA ICS 1.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.

B. Manufacturer's representative shall perform tests and inspections and prepare test reports.

C. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.

1. Perform recommended installation tests as recommended in manufacturer's installation and service manuals.

2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

b. Verify time-delay settings.

c. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

3.5 DEMONSTRATION

A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.

1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, and emergency operation procedures.

2. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

December 11, 2024

SECTION 26 41 00
LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 SCOPE

Furnish all labor, materials, equipment, appliances and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

A. Air terminals and interconnecting conductors.
B. Grounding and bonding for lightning protection.

1.2 APPLICABLE SECTIONS

The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following;

A. Section 26 05 00 - Electrical General Requirements.
B. Section 26 05 19 - Conductors and Cables.

1.3 REFERENCES

A. LPI-175 - Lightning Protection Installation Standard.
B. LPI-176 - Lightning Protection System Material and Components Standard.
C. LPI-177 - Inspection Guide for LPI Certified Systems.
D. NFPA 78 - Lightning Protection Code.
E. UL 96 - Lightning Protection Components.
F. UL 96A - Installation Requirements for Lightning Protection Systems.

1.4 SYSTEM DESCRIPTION

A. Lightning Protection System: Conductor system protecting consisting of air terminals on roofs, roof-mounted mechanical equipment, chimneys and stacks, parapets, bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors.

1.5 SUBMITTALS FOR REVIEW

A. Section 26 05 00 – Electrical General Requirements: Procedures for submittals.
B. Shop Drawings: Indicate layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
C. Product Data: Provide dimensions and materials of each component, and include indication of listing in accordance with UL 96.

1.6 PROJECT CLOSEOUT SUBMITTALS

A. Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 70.
B. Perform Work in accordance with UL 96A
C. Perform Work in accordance with LPI-175

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in lightning protection equipment with minimum three years experience and member of the Lightning Protection Institute.
B. Installer: Authorized installer of manufacturer with minimum three years experience and certified by the Lightning Protection Institute.

1.9 REGULATORY REQUIREMENTS

A. Product Listing: UL 96 and LPI-176.
B. System shall be UL listed and certified.

1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.11 COORDINATION

A. Coordinate work with roofing and exterior and interior finish installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND INSTALLERS

A. VFC Corporation. North Salt Lake, Utah.
B. Robbins Lightning, Inc.

2.2 COMPONENTS

A. Air Terminals: Copper solid with adhesive bases for single-ply roof installations.
B. Air Terminal for Chimney: Lead-coated copper.
C. Grounding Rods: Solid copper
D. Ground Plate: Copper.
E. Conductors: Copper cable
F. Connectors and Splices: Bronze

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with NFPA 78, UL 96A and LPI-175.

B. Connect conductors using exothermic welding process. Protect adjacent construction elements and finishes from damage. All welds shall be witnessed by the OWNER.
C. Bond exterior metal bodies on building to lightning protection system and provide intermediate level interconnection loops 60 feet (18 m) on center.

3.2 FIELD QUALITY CONTROL

A. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and labeling of the lightning protection system in accordance with UL 96A.
B. Obtain the services of the Lightning Protection Institute to provide inspection and certification of lightning protection system in accordance with LPI-177.

END OF SECTION

December 11, 2024

SECTION 265113
INTERIOR LUMINAIRES

PART 1 - GENERAL

1.01 SCOPE

A. Furnish all labor, materials, equipment, appliances and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

1. Interior luminaires and accessories.
2. Emergency lighting units.
3. Exit signs.
4. Ballasts.
5. Fluorescent lamp emergency power supply.
6. Lamps.
7. Luminaire accessories.

1.02 APPLICABLE SECTIONS

A. The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following;

B. Section 260500- Electrical General Requirements.

1.03 REFERENCES

A. ANSI C78.379 - Electric Lamps - Incandescent and Issued October 1993 High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.

B. ANSI C82.1 - Ballasts for Fluorescent Lamps -Specifications.

C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).

D. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

E. NFPA 70 - National Electrical Code.

F. NFPA 101 - Life Safety Code.

1.04 SUBMITTALS FOR REVIEW

A. Section 260500 - Electrical General Requirements

B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

1.05 SUBMITTALS FOR CLOSEOUT

A. Section 260500 - Electrical General Requirements

B. Submit manufacturer's operation and maintenance instructions for each product.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Conform to requirements of NFPA 101.

C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.08 EXTRA PRODUCTS

A. Section 260500 - Contract Closeout.

B. Furnish 10% or a minimum of two of each lens type.

C. Furnish one case of replacement fluorescent lamps for each lamp type. Furnish two replacement lamps for each size HID lamp type and LED assembly.

D. Furnish 10% or a minimum of two of each ballast type or driver type.

PART 2 - PRODUCTS

2.01 LUMINAIRES

A. Furnish Products as scheduled. Refer to Section 260500 for substitutions and product options.

B. Lighting Fixtures: Shall be as shown in the Lighting Fixture Schedule on the Drawings.

2.02 LED LUMINAIRE WARRANTY

A. Provide a written 5-year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.

1. Include finish warranty to include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.
2. Material warranty must include:
   a. All drivers.
   b. Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.

B. Warranty period must begin on date of beneficial occupancy. Provide the Contracting Officer with signed warranty certificates prior to final payment.

2.03 PROVIDE LUMINAIRE USEFUL LIFE CERTIFICATE

A. **Submit certification from the manufacturer** indicating the expected useful life of the luminaires provided. The useful life must be directly correlated from the IES LM-80 test data using procedures outlined in IES TM-21. Thermal properties of the specific luminaire and local ambient operating temperature and conditions must be taken into consideration.

2.04 LUMINAIRES

A. UL 1598, NEMA C82.77, and UL 8750. Provide luminaires as indicated in luminaire schedule and NL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. Provide all luminaires of the same type by the same manufacturer.Luminaires must be specifically designed for use with the driver, ballast or generator and light source provided.

2.05 LED LUMINAIRES

A. Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life in luminaire schedule on project plans for LED luminaires. LED luminaires must meet the minimum requirements in the following table:

B. LED luminaires must also meet the following minimum requirements:

LUMINAIRE TYPE	MINIMUM LUMINAIRE EFFICACY (LE)	MINIMUM COLOR RENDERING INDEX (CRI)
LED TROFFER – 1 x 4300 x 1200 2 x 2600 x 600 2 x 4600 x 1200	90 LPW	80
LED Downlight	50 LPW	90
LED Track or Accent	40 LPW	80
LED Low Bay/High Bay	80 LPW	70
LED Linear Ambient	80 LPW	80

a. Luminaires must have a minimum 5-year manufacturer's warranty.

b. Luminaires must have a minimum L70 lumen maintenance value of 50,000 hours as calculated by IES TM-21, with data obtained per IES LM-80 requirements.

c. Luminaire drive current value must be identical to that provided by test data for luminaire in question.

d. Luminaires must be tested to IES LM-79 and IES LM-80 standards, with the results provided as required in the Submittals paragraph of this specification.

2.08 LUMINAIRES FOR HAZARDOUS LOCATIONS

In addition to requirements stated herein, provide LED luminaires for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

2.09 LED DRIVERS

NEMA SSL 1, UL 8750. LED drivers must be electronic, UL Class 1, constant-current type and comply with the following requirements:

a. Output power (watts)and luminous flux (lumens) as shown in luminaire schedule for each luminaire type to meet minimum luminaire efficacy (LE) value provided.

b. Factor (PF) greater than or equal to 0.9 over the full dimming range when provided.

c. Current draw Total Harmonic Distortion (THD) of less than 20 percent.

d. Class A sound rating.

e. Operable at input voltage of 120-277 volts at 60 hertz.

f. Minimum 5-year manufacturer's warranty.

g. RoHS compliant.

h. Integral thermal protection that reduces or eliminates the output power if case temperature exceeds a value detrimental to the driver.

i. UL listed for dry or damp locations typical of interior installations.

j. Non-dimmable, or fully-dimmable to 1% using 0-10V, or 3 wire, control as indicated in luminaire schedule and on drawings.

2.16 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type and wattage as indicated in luminaire schedule on project plans.

A. LED Light Sources

a. Correlated Color Temperature (CCT) of 3000 or 4000 degrees K as indicated.

b. Minimum Color Rendering Index (CRI) R9 value of 80.

c. High power, white light output utilizing phosphor conversion (PC) process or mixed system of colored LEDs, typically red, green and blue (RGB).

d. RoHS compliant.

e. Provide light source color consistency by utilizing a binning tolerance within a 3 step McAdam ellipse.

2.17 CONTROLS

A. Dual Technology Wall Mounted Occupancy Sensors: Spaces indicated on drawings shall be equipped with a dual technology occupancy sensor DT-100L as manufacturer by Wattstopper. The sensors shall be connected to a power supply as specified above. The sensor shall comply with the following specifications:
   a. Shall utilize PIR and Ultrasonic technologies with an adjustable integrated light level sensor for 2.5 to 430 foot-candles. The output shall be a single-pole, double-throw isolated relay.
   b. Shall utilize 40Khz +/- .006% ultrasonic frequency.
   c. Shall provide an adjustable time delay of 15 seconds to 15 minutes and an LED indicator for both technologies.
   d. Shall provide adjustable sensitivities, and shall be capable of installing two units per power pack.
   e. Shall be UL listed with a 5 year warranty.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
B. Support luminaires independent of ceiling grid, if layin type ceilings or concealed spline ceilings ore used.
C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

3.02 INSTALLATION OF LIGHTING FIXTURES

A. Install all lighting fixtures complete and ready for service, in accordance with the Fixture Schedule on the Drawings:
B. Wire all fixtures with fixture wiring of at least 150 degree C rating. Conductors in wiring channels of fixtures mounted in rows shall be the same size as the circuit wiring supplying the rows.
C. Install all fluorescent fixtures straight and true with reference to adjacent walls.
D. Install all lighting fixtures, including those mounted in continuous rows, so that the weight of the fixture is supported either directly or indirectly by a sound and safe structural member of the building, using adequate number and type of fasteners to ensure a safe

installation. Screwed fastenings and toggles through ceiling or wall material are not acceptable. Provide suitable connectors or collars to connect adjoining fixtures in continuous rows.

E. Do not support fixtures from roof deck. Provide unistrut channels spanning space between roof joists to support fixtures and outlets.

F. Fixtures mounted in lay-in grid ceilings shall have safety support wires to structural roof members as detailed for seismic restraint.

G. All single outlets shall be properly centered in each room. Where two or more outlets occur, they shall be spaced uniformly and in straight lines with each other.

H. Provide plaster frames and support channels around ceiling openings for recessed fixtures. Securely fasten to ceiling structural members.

I. Terminate circuits for recessed fixtures in an extension outlet box adjacent to ceiling opening and connect to fixtures with flexible steel conduit.

J. Where lighting fixtures and other electrical items are shown in conflict with locations and structural members and mechanical or other equipment, provide all required supports and wiring to clear the encroachment.

3.03 ADJUSTING

A. Section 260500 Contract Closeout

3.04 CLEANING

A. Section 260500 - Contract Closeout: Cleaning installed work.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosures.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

3.05 DEMONSTRATION AND INSTRUCTIONS

A. Section 260500 - Contract Closeout - Starting of Systems: Demonstrating installed work.

B. Demonstrate luminaire operation for 12 hours.

3.06 PROTECTION OF FINISHED WORK

A. Re-lamp or repair/replace luminaires that have failed at substantial completion.

END OF SECTION

SECTION 31 10 00
SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Protection of existing features.

B. Surface debris removal.

C. Removal and disposal of trees, shrubs, and grasses.

D. Stripping and stockpiling of topsoil.

E. Clean-up.

1.2 RELATED SECTIONS

A. Section 01 50 00 –Temporary Facilities and Controls

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that existing plant life designated to remain is tagged or identified.

3.2 PROTECTION

A. Locate, identify, and protect utilities that remain from damage.

B. Protect all trees which are to remain from damage.

C. Protect plant growth, and features designated to remain, as final landscaping or outside of construction limits.

D. Retain and protect benchmarks, survey monuments, and existing structures and utilities from damage or displacement.

E. Protect roads, fences, equipment in the right of way and other items to remain during construction.

F. Protect all adjoining property.

G. Protect existing drainage ditches, channels, and features.

H. Prevent air pollution or dust from becoming a nuisance to the public, to neighbors, and to others performing work on or near the project site. Comply with governing regulations.

3.3 CLEARING

A. Clear areas required for access to site and execution of Work.

B. Remove trees, brush, and shrubs as necessary for construction of the Work. Removal shall remain within construction limits and in areas for which easements have been acquired. Remove stumps and roots completely. Take care not to disturb existing utilities.

C. Limit clearing and construction operation to areas required for construction of the Work and designated by the Engineer.

3.4 REMOVAL

A. Remove debris and extracted plant life and dispose of off-site. Burning of removed vegetation or debris on site is prohibited, unless approved by the Engineer. Burial of removed vegetation or debris in backfill or trenches is prohibited.

B. Strip all heavy soils, heavy growths of grass, and sod that comprise the organic root-zone and dispose of off-site or locations provided by the Owner. The depth of stripping will generally be four (4) inches.

C. After removal of top grass layer, topsoil shall be stripped to a minimum 12” depth and stockpiled at areas designated in the drawings or as directed by the Engineer for use during final grading.

D. Topsoil stockpile shall be separated from other soil materials to prevent contamination.

E. Dispose all materials at locations that comply with all Federal, State, and Local Regulations.

F. Grade areas in which groundwater is encountered to drain.

3.5 OBSTRUCTIONS

A. Remove and replace fences, fence post, signs and any structures encountered during construction to a condition equal to or better than it was prior to construction.

3.6 CLEANUP

A. Upon completion of the site work and project, clean the entire work area. Remove all excess excavated material, rocks, boulders, logs, trees, pipe, deleterious material, or debris of any type from the site and dispose at a site acceptable to Federal, State, and Local Regulations.

B. Place and level excess stripped topsoil material remaining at site as directed by the Engineer.

END OF SECTION

SECTION 31 22 13
ROUGH GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Examination

B. Preparation

C. Removal and Disposal

D. Excavation

E. Filling

F. Tolerances

G. Field Quality Control

1.2 REFERENCES

A. ASTM C136 - Method For Sieve Analysis of Fine and Coarse Aggregates.

B. ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb (2.49 Kg) Rammer and 18-inch (304.8 mm) Drop.

C. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

D. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.3 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 77 00 – Closeout Procedures.

B. Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 PRODUCTS

2.1 MATERIALS

A. Subsoil Fill: Type S1 as specified in Section 32 05 13 – Soils for Exterior Improvements.

B. Structural Fill: Type A1, A2, and A5 as specified in Section 32 05 16 – Aggregates for Exterior Improvements.

C. Granular Fill: Type A1, A2, A3, A4, and A5 as specified in Section 32 05 16 – Aggregates for Exterior Improvements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Section 01 31 00 – Project Management and Coordination.

B. Verify that survey benchmark and intended elevations for the Work are as indicated.

3.2 PREPARATION

A. Contractor is responsible to protect all construction stakes and benchmarks. If original survey stakes or markers are destroyed, they will be replaced at the Contractors expense.

B. Identify required lines, levels, contours, and datum.

C. Stake and flag locations of known utilities.

D. Locate, identify, and protect utilities that remain from damage.

E. Notify and coordinate work with utility companies to remove and relocate utilities as necessary.

F. Protect above and below grade utilities that remain.

G. Protect soil from erosion.

H. Protect plant life, lawns, and other features remaining as a portion of final landscaping.

I. Protect benchmarks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic. Replace if damaged at no additional cost to Owner.

3.3 REMOVAL AND DISPOSAL

A. Remove all shrubs including the roots from areas of construction excavation as described in Section 31 10 00 – Site Clearing.

3.4 EXCAVATION

A. Excavate material per Section 31 23 16 – Excavation

3.5 FILLING

A. Place fill material per Section 31 23 23 – Fill

B. Make grade changes gradual. Blend slope into level areas.

C. Abate dust during construction using water from an approved source.

3.6 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.7 FIELD QUALITY CONTROL

A. Section 01 45 00 – Quality Control: Field inspection and testing.

B. Testing: In accordance with ASTM D1557 and ASTM D2922 or as noted on plans.

C. If tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

D. Frequency of Tests: As required to assure quality.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavation for structures, utilities, paving, and landscaping.

1.2 RELATED SECTIONS

A. Section 01 22 00 – Measurement and Payment

B. Section 01 40 00 – Quality Requirements

C. Section 01 50 00 – Temporary Facilities and Controls

D. Section 31 22 13 – Rough Grading

E. Section 31 23 17 – Trenching

F. Section 32 05 13 – Soils for Exterior Improvements

G. Section 32 05 16 – Aggregates for Exterior Improvements

1.3 FIELD MEASUREMENTS

A. Verify that survey benchmark and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 PREPARATION

A. Identify required lines, levels, contours and datum.

B. Verify location of potentially conflicting utilities.

C. Protect utilities indicated to remain from damage.

D. Coordinate with utility owners to allow relocation of utilities if necessary.

E. Protect any plant life and other features remaining as portion of final landscaping.

F. Protect any benchmarks, survey control points, existing structures, fences, paving, and other existing items from excavating equipment and vehicular traffic.

3.2 GENERAL EXCAVATION

A. Underpin or shore up adjacent structures which may be damaged by excavation work, including utilities and embankments.

B. Excavate subsoil to the lines and grades shown on the plans required to accommodate building and structure construction, paving, and construction operations. Dewater as necessary to maintain excavation.

C. Grade top perimeter of excavation to prevent surface water from draining into excavated area.

D. Hand trim excavation. Remove loose matter.

E. Remove lumped subsoil, frozen subsoil and boulders.

F. Compact excavated area to ninety-five percent (95%) maximum density of ASTM D1557 for buildings and paving areas and ASTM D698 for utilities prior to placing Type A2 aggregate material.

G. Notify Engineer of unexpected subsurface conditions.

H. Correct unauthorized excavation at no extra cost to Owner.

I. Correct areas over excavated by filling with Type A2 aggregate material and compacting to ninety-five percent (95%) maximum density of ASTM D1557 for buildings and paving areas and ASTM D698 for utilities.

J. Stockpile excavated material in a designated place. Stockpiles must be protected from eroding until final placement is achieved.

K. Repair utilities and other items which are intended to remain, which are damaged during excavation, at no additional cost to Owner.

3.3 EXCAVATION FOR FOOTINGS

A. Preparation: To minimize differential settlement it is essential that earth surfaces upon which footings will be placed, be compacted in accordance with the compaction requirements and be protected from rain and runoff. No footing shall be placed on saturated material. Footing foundation material which becomes saturated during construction due to lack of protection by the Contractor shall be over excavated to suitable material and backfilled with suitable foundation soil at no cost to the Owner.

B. Foundation trenches shall be protected from ground water by providing a low spot and pumping, or by other means which shall dispose of subsurface water.

3.4 FIELD QUALITY CONTROL

A. Field inspection will be performed under provisions of Section 01 40 00 – Quality Requirements.

B. Provide visual inspection of bearing surfaces and compaction testing.

3.5 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Prevent water from ponding on excavated surfaces.

D. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 31 23 17
TRENCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavate trenches for pipelines.

B. Compacted fill from top of pipe bedding to subgrade elevations.

C. Backfilling and compaction.

1.2 REFERENCES

A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

B. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb. Rammer and 18-inch Drop.

C. ASTM D2049 - Test Method for Relative Density of Cohesionless Soils.

D. ASTM D2922 - Test Methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).

E. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Samples: Submit 45 lb (20 kg) sample of each type of soil and aggregate materials to testing laboratory, in airtight containers.

1.4 FIELD MEASUREMENTS

A. Verify that survey benchmark and intended elevations for the Work are as shown on Drawings.

1.5 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 PRODUCTS

2.1 FILL MATERIALS

A. Types of materials as specified in Section 31 23 23 - Fill.

2.2 BEDDING MATERIALS

A. Type A3 Aggregate as specified in Section 32 05 16 – Aggregates for Exterior Improvements.

2.3 FOUNDATION MATERIALS

A. Type A4 aggregate as specified in Section 32 05 16 – Aggregates for Exterior Improvements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify fill material to be reused is acceptable.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Verify location, maintain and protect existing utilities which pass through work area.

C. Protect plant life, lawns, and other features remaining as a portion of final landscaping.

D. Protect benchmarks, existing structures, fences, sidewalks, paving, curbs, and other existing items from excavation equipment and vehicular traffic.

E. Protect above and below grade utilities which are to remain.

F. Underpin adjacent structures which may be damaged by excavation.

G. Have utility poles supported which may become undermined by excavation.

H. Establish temporary traffic control and/or detours when trenching is performed within a vehicular travel way. Relocate controls and reroute traffic as required during progress of Work.

I. Provide means by which natural drainage ways can be diverted away during trenching. Do not permit runoff water to enter the trench.

3.3 TRENCH PROTECTION

A. Provide trench box, sheet, shore, and/or brace excavations to provide trench protection as necessary to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Design any sheeting and shoring to be removed at completion of excavation work.

C. Repair damage caused by failure of the sheeting, shoring, bracing, or other trench protection and for settlement of filled excavations or adjacent soil.

3.4 TRENCHING

A. Excavate subsoil required for utilities.

B. Remove lumped subsoil, boulders, and rock.

C. Cut trenches sufficiently wide to enable installation and allow inspection of utilities.

D. Do not advance open trench more than 500 feet ahead of installed pipe unless approved by Engineer.

E. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and utilities.

F. Excavation shall not interfere with normal 45 degree bearing splay of foundations.

G. As directed by engineer, cut out soft areas of subgrade not capable of insitu compaction. Backfill with Structural Fill Type A2 fill as necessary and compact to density equal to or greater than requirements for subsequent backfill material.

H. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.

I. Correct unauthorized excavation at no cost to Owner.

J. Correct areas over-excavated by error in the following manner:
   1. Areas other than those listed above: Fill to correct lines with similar native material compacted to ninety-five (95%) maximum density as determined by ASTM D1557.

K. Stockpile excavated material in area designated and remove excess material not being used.

3.5 BEDDING AND FOUNDATION MATERIAL

A. Support pipe and conduit during placement and compaction of bedding.

B. Use Type A4 aggregate for foundation material as required by the groundwater conditions and as approved by the Engineer.

3.6 BACKFILLING

A. Backfill trenches per Section 31 23 23 – Fill.

B. Do not leave more than 50 feet of trench open at end of working day.

C. Protect open trench to prevent danger to the public.

3.7 TOLERANCES

A. Structures and Paved Areas
   1. Top Surface of Backfilling: Plus or minus 0.10 foot from required elevations.

B. General Open and Landscaped Areas
   1. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

3.8 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 45 00 – Quality Control.

B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM C136 and ASTM D1557 and with Section 01 45 00 – Quality Control.

C. Tests and analysis of bedding will be performed in accordance with ASTM D2049, ASTM 1557 and with Section 01 45 00 – Quality Control.

D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

E. Frequency of Tests: As required to assure quality of work.

3.9 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 50 00 – Temporary Facilities and Controls.

B. Recompact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 23 18
ROCK REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Rock excavation including drilling, blasting, rock trenching, hammering and other methods of rock removal, and related work.

1.2 RELATED SECTIONS

A. Section 01 22 00 – Measurement and Payment

B. Section 01 33 00 – Submittal Procedures

C. Section 01 40 00 – Quality Requirements

D. Section 31 23 17 – Trenching

1.3 REFERENCES

A. NFPA 495 – Explosive Materials Code

1.4 DEFINITIONS

A. "Rock" is classified as material which by actual demonstration cannot be reasonably excavated, in the opinion of the Engineer, by a 55,000 lb. track hoe equipped with 33-foot ground level reach, ¾ cubic yard general duty bucket with rock points.

B. "Rock" is solid sandstone, limestone, granite, basalt, or other solid rock of equal hardness, in ledges, bedded deposits, or unstratified masses that, in the opinion of the Engineer, will require the use of systematic drilling and blasting, splitting with a chemical, hydraulic or pneumatic rock splitter or other means of fracturing for removal.

C. Rock excavation includes removal of boulders within the neatline dimensions of the trench which have a volume in excess of ¾ cubic yard.

D. Cemented gravel (conglomerate), shale, clay, and other sedimentary materials are classified as rock only when, in the opinion of the Engineer, systematic drilling and blasting or other similar methods are required for removal.

E. Loam, sand, gravel, clay, caliche, or other such material stratified between layers of rock will not be classified as rock.

1.5 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Submit intended rock removal method.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Construction materials and equipment used for the work to meet all requirements of the Contract Documents.

B. Use, handle and store material in such a manner as to preserve quality and fitness for the work.

C. Immediately remove materials from site of work that do not conform to the requirements of the Contract Documents as determined by the Engineer.

PART 3 EXECUTION

3.1 GENERAL

A. Perform rock excavation, as necessary, at the locations indicated in the Contract Documents.

B. Accurately grade bottom of excavation and trenches to the lines and grade indicated in the Contract Documents.

3.2 EXAMINATION

A. Verify site conditions and note subsurface irregularities affecting Work of this section.

3.3 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Unless otherwise specified, remove all loam, sand, gravel, clay, or other such materials above the rock and clean off the exposed rock surface in a satisfactory manner so that the Engineer may examine the surface and obtain pay quantity measurements prior to rock removal.

C. Comply with all requirements of Section 31 23 16 - Excavation and Section 31 23 17 - Trenching.

3.4 BLASTING GENERAL SAFETY

A. Comply with NFPA 495 – Explosive Materials Code, and federal, state and local rules and regulations regarding transporting, handling and use of explosives.

B. Assume all liability and responsibility connected with or accruing from blasting, or the use of explosives including but not be limited to, damage to work or adjacent property

injuries, lawsuits, complaints, and all other adverse results, actual, alleged, inferred, or implied.

C. Secure required permits prior to blasting. Submit a blasting plan for review by the Engineer indicating amounts of rock to be removed, schedule and methods used to mitigate impacts to surrounding structures, utilities, private residences, and traffic.

D. Do not blast during weekends, holidays or outside normal working hours, unless otherwise approved by the Engineer.

E. Use utmost care to protect life and property. Safely and securely store explosives in compliance with State, Federal and local laws and ordinances, clearly marking such storage places "Dangerous Explosives." Do not leave explosives unprotected in areas where persons or property could be endangered.

F. Where no local laws or regulations apply, provide storage not closer than 1,000 feet from any road, building, camping area or place of human occupancy.

3.5 ROCK REMOVAL BY MECHANICAL METHOD

A. Excavate and remove rock by mechanical method including but not limited to, drilling holes and use of expansive tools, wedges, or chemical grouts to fracture rock, rock trenching or sawing, or rock hammering.

B. Cut away rock at bottom of excavation to form level bearing.

C. Remove loose material and shaled layers to provide sound and unshattered base for footings, foundations, or pipe bedding.

D. In utility trenches, excavate to 4 inches below the bottom of the pipe and 24 inches wider than pipe diameter.

3.6 ROCK REMOVAL BY EXPLOSIVE METHODS

A. When rock is uncovered requiring explosives method for rock disintegration, notify Engineer.

B. Disintegrate rock and remove from excavation.

C. Cut away rock at bottom of excavation to form level bearing.

D. Remove shaled layers to provide sound and unshattered base for footings, foundations, or pipe bedding.

E. In utility trenches, excavate to 4 inches below invert elevation of pipe and 24 inches wider than pipe diameter.

3.7 DISPOSAL OF EXCAVATED ROCK

A. Haul away and dispose of all excavated rock that is unsuitable for backfill to areas approved by the Engineer.

B. If the removal of excavated rock causes a deficiency in the amount of material available to complete the backfilling of any portion of the excavation or trench, import suitable backfill material in such quantity as may be required to complete the backfilling of the area. Imported backfill will not be measured for over excavated areas.

3.8 FIELD QUALITY CONTROL

A. Geotechnical Engineer to visually inspect foundation-bearing surfaces before Contractor installs subsequent work.

END OF SECTION

SECTION 31 23 23
FILL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Trench filling and backfilling.

B. Backfilling areas excavated for structures.

C. Consolidation and compaction.

D. Fill under paving.

E. Fill for over-excavation.

1.2 REFERENCES

A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

B. ANSI/ASTM D698 - Test Methods for Moisture – Density Relations of soil and soil aggregate mixtures, using 5.5 lb. Rammer and 12” drop.

C. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb. Rammer and 18-inch Drop.

D. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

E. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Samples: Submit 45 lb. sample of each type of aggregate and soil materials to testing laboratory, in air-tight containers.

C. Submit all sample and compaction test results to Engineer.

PART 2 PRODUCTS

2.1 BACKFILL MATERIALS

A. Native materials free of shale, clay, friable material and debris with a maximum aggregate size that does not exceed 4 inches and approved by the engineer.

B. Type A2 Aggregate specified in Section 32 05 16 – Aggregates for Exterior Improvements.

C. Subsoil Type S1 specified in Section 32 05 13 – Soils for Exterior Improvements.

2.2 BEDDING MATERIALS

A. Type A3 Aggregate as specified in Section 32 05 16 – Aggregates for Exterior Improvements.

2.3 FOUNDATION AND BASE MATERIALS

A. Structures
   1. Type A6 Aggregate as specified in Section 32 05 16 – Aggregates for Exterior Improvements and shown on the Drawings compacted to 95% minimum.

B. Roadways
   1. Type A5 Aggregate as specified in Section 32 05 16 – Aggregates for Exterior Improvements.

C. Pipelines
   1. Type A4 Aggregate as specified in Section 32 05 16 – Aggregates for Exterior Improvements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify fill materials to be used are acceptable.

B. Where applicable, verify subdrainage, dampproofing, or waterproofing installation has been inspected.

C. Verify structural ability of unsupported walls to support loads imposed by fill.

D. Project Engineer must review all excavations prior to backfill.

3.2 PREPARATION

A. Compact subgrade to density requirements for subsequent backfill materials. Scarify, wet and recompact, if necessary, to achieve densities.

B. Cut out soft areas of subgrade not capable of insitu compaction. Backfill with Structural Fill Type A2 fill as necessary and compact to density equal to or greater than requirements for subsequent backfill material.

C. Prior to placement of any fill material, scarify to 8" and compact subgrade to ninety-five percent (95%) of its maximum dry density in accordance with ASTM-D1557.

3.3 FILLING

A. Backfill areas to contours and elevations with the material(s) specified in Part 2 of this section.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces. If wet, frozen, porous, spongy or other unsuitable materials are encountered, backfill with import material at no additional cost to Owner.

C. Place and compact fill material on continuous layers as follows:

1. Structural Fill:
    a. Fill Type A1 and A2: Maximum 8 inches compacted depth.
    b. Compact to a minimum of 95 percent of maximum dry density.
2. Pipeline Backfill:
    a. Fill Type A3 and A4: Maximum 8 inches compacted depth.
    b. Compact to a minimum of 95 percent of maximum dry density under structures and roadways and 92 percent of maximum dry density elsewhere.
3. Untreated Base Course
    a. Fill Type A5: Maximum 6 inches compacted depth.
    b. Compact to a minimum of 95 percent of maximum dry density.
4. Site Fill (not under roadways or structures):
    a. Fill Type S1, A1, and A2: Maximum 8 inches compacted depth per lift.
    b. Compact to a minimum of 92 percent of maximum dry density.

D. Employ a placement method that does not disturb or damage existing structures or utilities.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Do not backfill against unsupported foundation walls unless approved by the Engineer.

G. Slope grade away from structures at a minimum 5 percent slope for a minimum distance of 10 feet horizontally, unless noted otherwise.

H. Remove surplus and unusable backfill materials from site.

I. Leave fill material stockpile areas completely free of excess fill materials.

3.4 TOLERANCES

A. Structures and Paved Areas
   1. Top Surface of Backfilling: Plus or minus 0.10 foot from required elevations.

B. General Open and Landscaped Areas
   1. Top Surface of Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL

A. Field testing will be performed under provisions of Section 01 45 00 – Quality Control.

B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM C136 and ANSI/ASTM D1557 and with Section 01 45 00 – Quality Control.

C. Compaction testing will be performed in accordance with ASTM D1557 and ASTM D2922 and with Section 01 45 00 – Quality Control.

D. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to Owner.

E. Frequency of Compaction Tests: As required to assure quality of work.

F. Proof roll compacted fill surfaces under foundations, slabs-on-grade, pavers, and paving.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Section 01 50 00 – Temporary Facilities and Controls.

B. Recompact fills subjected to vehicular traffic before placement of subsequent layers.

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 GENERAL

A. Section includes erosion control blanket to prevent soil loss by temporarily stabilizing and protecting disturbed soil from raindrop impact and surface erosion, to increase infiltration, decrease compaction and soil crusting, and to conserve soil moisture. Mulching with erosion control blankets to increase the germination rates for grasses and promote vegetation establishment for a permanent erosion control system. Erosion control blankets to protect seeds from predators, reduce desiccation and evaporation by insulating the soil and seed environment. This specification does not apply to other types of light weight soil erosion control materials such as open weave jute netting.

B. The work to be performed under this section shall consist of furnishing all materials, labor, and plants necessary for the proper seeding of the kind and sizes specified at the prescribed locations, and otherwise in accordance with the drawings and specifications or as directed by the Landscape Architect.

1.2 REFERENCES

A. Erosion Control Technology Council (ECTC) Guidelines:
1. Light Penetration
2. Swell

B. American Society for Testing and Materials (ASTM)
1. D1117 – Water Absorption
2. D1388 – Stiffness of Fabrics, “Option A”
3. D1777 – Resiliency
4. D4354 – Practice for Sampling of Geosynthetics for Testing
5. D4491 – Permittivity
6. D5035 – Tensile Strength
7. D5035 – Elongation
8. D5199 – Thickness
9. D5261 – Mass per Unit Area

C. Accredited Independent Testing Facilities:
1. Utah State Water Research Laboratory
2. San Diego State University Soil Erosion Laboratory
3. Precision Geosynthetic Laboratory
4. TRI Environmental Inc.

D. Federal Highway Administration (FHAWA) – Geosynthetic Design and Construction Guidelines

E. Salix Applied Earthcare

F. Texas Department of Transportation (TTI)

G. National Transportation Product Evaluation Program (NTPEP) – ECTC Bench Scale Test Methods are not recognized by this specification as an accredited material performance test method.

1.3 DEFINITIONS

A. Minimum Average Roll Value (M): Property value calculated as typical minus two standard deviations. Statistically, it yields a 97.7 percent degree of confidence that nay sample taken during quality assurance testing will exceed value reported.

B. RECB: Rolled Erosion Control Blankets are generally a machine-produced mat of organic, biodegradable mulch such as straw, curled wood fiber (excelsior), coconut fiber, or a combination thereof, evenly distributed on or between photodegradable polypropylene or degradable natural fiber netting.

C. OWT: Open Weave Textiles are processed natural and/or polymer yarns woven into a matrix.

1.4 SUBMITTALS

A. Certification: The CONTRACTOR shall provide to the ENGINEER a certificate stating the name of the manufacturer, product name, style number, chemical composition of the fiber, netting, thread, and all other pertinent information to fully describe the erosion control blanket. The Certification shall state that the furnished erosion control blanket meets the performance requirements of this specification as evaluated under the manufacturer's quality control program. The Certification shall be attested to by a person having legal authority to bind the manufacturer.

B. A certificate of weed free status shall be available from the manufacturer. The manufacturer shall use straw that is Certified Weed Free Forage under California Food and Agriculture Code Section 5101 and 5205.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Manufacturers permitted to furnish materials under this specification shall submit a written quality control program conforming to the requirements of Section 2.2 Quality control.
   2. Manufacturers permitted to furnish materials under this specification shall maintain recurrent material testing to ensure minimum quality standards are being met, conforming to the requirements of Section 2.2 Quality Control.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Erosion control blanket labeling, shipment, and storage shall follow ASTM D 4873 or the manufacturer's written storage and handling procedures. Product labels shall clearly show the manufacturer or supplier name, and blanket type name.

PART 2 PRODUCTS

2.1 MATERIALS

A. Rolled Erosion Control Blanket (RECB)

1. The RECB shall be machine produced using 100% certified weed free agricultural straw fibers evenly distributed over the entire area of the blanket. The straw fibers shall be sewn into a medium weight photodegradable top net on 1.5 inch centers with cotton polyester or polypropylene thread. Natural fiber threads shall not be allowed to ensure conformance with this specification. The blankets shall be at a minimum 60 sq. yards per roll.
2. Light weight open weave jute netting (OWT) shall not be allowed under this specification.
3. The RECB shall meet the minimum performance requirements of Table 1. The product must be guaranteed to meet all numeric performance values in Table 1 under the specific conditions as stated.

TABLE 1 – TEMPORARY EROSION CONTROL BLANKET

Property	Test Method	Units	Min Value	Material	Unit	Min. Value
Tensile Strength MD	ASTM D 5035	lbs/in	6.1	Top Net	lbs/1000 ft^2	1.6
Tensile Strength TD	ASTM D 5035	lbs/in	5.0			
Thickness	ASTM D 5199	inches	0.35	Bottom Net	lbs/1000 ft^2	N/A
Mass per Unit Area	ASTM D 5261	lbs/yd^2	0.5			
Soil Loss[2]	Rainfall Sim.[2]	(lbs/hr)^2	1.9 max.	Thread	lbs/ft	17.0
Germination Ratio[2]	Rainfall Sim.[2]	% of Total Pos.	70.2			
Apparent Opening Size	ASTM D 4751	inches	.625x.625	Straw Fiber	Avg. Length (in.)	3.0
Light Penetration	ECTC	% Penetration	30 max			

[1]A measured in accordance with applicable ASTM standard.

[2]Minimum 5 in./hr. – Minimum Duration .75 hrs. or 10 year storm event on 2:1 slope with Sandy Loam type soil.

[3]Minimum Allowable Break Load.

4. Approved RECB are as follows: Greenfix America WS05 Photodegradable Single Net Straw.

2.2 QUALITY CONTROL

A. Manufacturing Quality Control: Physical property testing shall be performed at an indoor laboratory accredited to perform such tests required for the RECB, at a frequency not to exceed annually. A certification of the recurrent testing requirement shall be provided by the manufacturer upon request. The certification shall at a minimum identify the test facility, manufacturer, product ID, test ID, and test date to verify conformance with manufacturer's published specification.

B. Manufacturers providing materials under this specification shall upon request submit a written description of the manufacturer's quality control program to verify conformance with this specification. Then manufacturer's quality control program shall include a guaranteed remedy for nonconforming material supplied to project.

C. Manufacturing Quality Control: Product performance testing shall be performed at an indoor laboratory accredited to perform such tests required for the RECB. Performance testing is required for all products provided under this specification. Products must be guaranteed to perform to the minimum performance standards under the specific conditions as stated in this specification. Manufacturer's performance certification and testing quality assurance shall be provided upon request to verify conformance with this specification.

PART 3 EXECUTION

3.1 GENERAL

A. Site Visit: The CONTRACTOR shall visit and inspect the site. He shall take into consideration known and reasonably inferable conditions affecting work. Failure to visit the site will not relieve the CONTRACTOR of furnishing materials and performing the work required.

3.2 PREPARATION

A. The installation site shall be prepared by clearing, grubbing, and excavations, compacting or filling to the design grade. This includes removal of topsoil and vegetation. This is essential to ensure complete contact of the protection matting with the soil.

B. Grade and shape area of installation.

C. Remove all rocks, clods, vegetative or other obstructions so that the installed blankets, or mats, will have direct contact with the soil.

D. Prepare seedbed by loosening 2-3 inches of topsoil below final grade.

E. Incorporate amendments, such as lime and fertilizer, into the soil according to soil tests and the seeding plan.

F. Seeding:
   1. Seed area before blanket installation for erosion control and re-vegetation. Seeding after mat installation is often specified for turf reinforcement applications. When seeding prior to blanket installation, all check slots and other area disturbed during installation must be reseeded.

3.3 INSTALLATION

A. For optimum performance this product should be installed with the net up.

B. The RECB shall be placed intimate contact with the soils without wrinkles or folds and anchored on a smooth, graded surface approved by the ENGINEER. The RECB shall be placed in such a manner that placement of the overlying materials will not excessively stretch so as to tear the RECB. Anchoring of the terminal ends of the RECB shall be accomplished through the use of key trenches or aprons at the crest and toe of the slope.

C. The RECB shall be placed with the machine direction parallel to the slope. For streambank and channel protection, the RECB shall be placed with the machine direction parallel to the direction of water flow and perpendicular to wave action. Adjacent RECB shall be joined by overlapping and anchoring. Ovelapped seams of roll ends shall be a minimum of 1.5 feet, except where placed under water. In such instance, the overlap shall be a minimum of 2.5 feet. Overlaps of adjacent rolls shall be a minimum of 3 inches in all instances.

D. When overlapping, successive sheets, the RECB shall be overlapped upstream over downstream, and/or upslope over downslope. In areas subject to high winds, RECB shall be overlapped upwind over downwind and/or upslope over downslope.

E. Care shall be taken during installation so as to avoid damage occurring to the RECB as a result of the installation process. Should the RECB be damaged during installation, a material patch shall be placed over the damaged area extending 3.0 feet beyond the perimeter of the damage.

F. The RECB placement shall begin at the crest and proceed down the slope. Placement shall take place so as to avoid stretching and subsequent tearing of the RECB.

G. Anchoring:
   1. U-shaped wire staples, metal geotextile stake pins, or triangular wooden stakes can be used to anchor mats to the ground surface. Wire staples should be a minimum of 11 gauge. Metal stake pins should be 3/16 inch diameter steel with a 1 1/2 inch steel washer at the head of the pin. Wire staples and metal stakes should be driven flush to the soil surface. All anchors should be 6-8 inches long

and have sufficient ground penetration to resist pullout. Longer anchors may be required for loose soils.

2. Blankets shall be stapled sufficiently to anchor blanket and maintain intimate contact with the soil. Staples shall be place down the center and staggered with the staples placed along the edges. Slopes 2:1 or greater require 2 staples per square yard. Moderate slopes, 2:1 to 3:1, require 1-2 staples per square yard. Gentle slopes require 1 staple per square yard.

H. Field monitoring shall be performed to verify that the placement does not damage the RECB.

I. Any RECB damaged during placement shall be replaced as directed by the ENGINEER, at the CONTRACTOR's expense.

END OF SECTION

SECTION 31 37 00
RIPRAP

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Riprap placed loose.

1.2 REFERENCES

A. AASHTO M 288: Geotextile Specification for Highway Applications

B. AASHTO T 96: Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

C. AASHTO T 104: Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate

1.3 SUBMITTALS

A. Submit data showing riprap source gradation, wear and soundness, and placement technique 10 working days before use.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Broken or irregular shaped, durable, angular, hard stone that is solid and non-friable; free from seams, cracks, or other structural defects.

B. Maximum wear not greater than 40 percent when tested. Refer to AASHTO T 96.

C. Maximum 16 percent weighted loss tested according to AASHTO T 104.

D. Loose riprap – Stones graded in size so as to produce a dense mass. The greatest dimension of 50 percent of the stone to be at least ⅔ times, but not more than 1½ times, the specified thickness of the riprap layer. Not more than 10 percent of the rock will have a dimension of less than one-tenth the indicated thickness of the riprap.

E. Hand-placed riprap – Stones not less than 3 inches in thickness, with 75 percent of stones being at least ⅓ of a cubic foot in volume.

2.2 ACCESSORIES

A. Geotextile Separation Fabric: 6 oz./SY non-woven, needle-punched polypropylene geotextile or approved equivalent, unless otherwise noted.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove all brush, trees, stumps, and other objectionable materials.

B. Provide a firm foundation by excavating to a dressed uniform surface conforming to the lines and grades shown in the plans.

C. Do not over-excavate and disturb compacted foundations or undisturbed soils outside of the required lines and grades shown on the plans. Obtain approval from Engineer before backfilling or installing geotextiles.

D. Install required geotextile separation fabric as shown on Drawings; lap edges and ends.

3.2 PLACEMENT

A. General
1. Place riprap at culvert pipe ends and as indicated on Drawings.
2. Installed Thickness: As indicated on Drawings.

B. Loose Riprap
1. Place stones to secure a rock mass conforming to the grades and dimensions shown on the plans. Distribute and manipulate the stones so that the larger rock fragments are uniformly distributed and the smaller rock fragments serve to fill the spaces between the larger fragments. Place in a manner that results in un-segregated, densely placed, uniform layers of riprap of the thickness indicated on the plans.
2. Excavate at the toe of the slope and embed riprap as shown in the plans to protect against undercutting.

C. Hand-Placed Riprap
1. Place and bed the stones, one against the other, and key together. Fill irregularities between stones with suitable size stones rammed tightly into place.
2. Provide an even, tight finished surface true to the dimensions shown in the plans.
3. Embed riprap below the ground surface as shown on plans.

D. Compacted Riprap
1. Place loose riprap conforming to this Section, article 3.2.B where indicated on the plans.

2. Compact properly placed loose riprap to create an un-segregated, dense, regular tight surface of graded interlocking sizes, true to the dimensions shown in the plans, and free from any irregular surface protrusions over 3 inches high.

E. Plated Riprap
   1. Place loose riprap according to this Section, article 3.2.B where indicated on the plans.
   2. Compact properly placed loose riprap by repeatedly striking the riprap surface with a steel (armor) plate, approximately 5 ft. by 5 ft. and weighing 6,000 lbs., dropped from a height of 3 to 5 ft.
   3. Compaction is complete when plating action has resulted in a reasonably uniform surface, true to the dimensions shown in the plans, and free from any irregular surface protrusions over 4 inches high.

END OF SECTION

SECTION 32 05 13
SOILS FOR EXTERIOR IMPROVEMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Trench Backfill Soil Materials.

B. Topsoil

1.2 REFERENCES

A. AASHTO T-99 - Moisture-Density Relations of Soils Using a 5.5-lb Rammer and twelve (12) inch Drop.

B. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer with a twelve (12) inch drop.

C. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb. Rammer and 18-inch Drop.

D. ASTM D2487 - Classification of Soils for Engineering Purposes.

E. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

F. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures in place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Samples: Submit, in airtight containers, 45 lb. (20 kg) sample of each type of soil trench backfill material to testing laboratory. Submit test results to Engineer.

C. Materials Source: Submit name of imported materials suppliers. Provide materials from same source throughout the work. Change of source requires Engineer's approval.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. Subsoil Type S1: Excavated and re-used material, graded, free of lumps larger than 4 inches, rocks larger than 4 inches, frozen material, and debris.

2.2 SOURCE QUALITY CONTROL

A. Inspection and testing will be performed under provisions of Section 01 45 00 – Quality Control.

B. Tests and analysis of soil material will be performed in accordance with AASHTO T-99, ANSI/ASTM D1557, ASTM D2922, and ASTM D3017. A minimum of five (5) tests must be done.

C. If tests indicate materials do not meet specified requirements, change material and retest at no cost to Owner.

PART 3 EXECUTION

3.1 STOCKPILING

A. Stockpile soil material on site, or as shown and described on the drawings.

B. Stockpile in sufficient quantities to meet project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.2 STOCKPILE CLEANUP

A. Remove stockpile, leave area in a clean and neat condition. Grade stockpile site surface to prevent free standing surface water.

END OF SECTION

SECTION 32 05 16
AGGREGATES FOR EXTERIOR IMPROVEMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aggregate materials for pipe bedding, structure foundation, site fill, roadway base course, import trench backfill, and drain rock.

1.2 REFERENCES

A. AASHTO T-99 - Moisture Density relations of soils using a 5.5 lb. rammer with a twelve (12) inch drop.

B. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

C. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer with a twelve (12) inch drop.

D. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb. Rammer and 18 inch Drop.

E. ASTM D2049 - Test Method for Relative Density of Cohesionless Soils.

F. ASTM D2487 - Classification of Soils for Engineering Purposes.

G. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

1.3 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Samples: Submit, in airtight containers, 45 lb. (20 kg) sample of each type of aggregate material to testing laboratory. Submit test results to Engineer.

C. Materials Source: Submit name of aggregate materials suppliers. Provide materials from same source throughout the work. Change of source requires Engineer approval.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIALS

A. Pipe Foundation Material – Aggregate Type A1: Angular, crushed stone free of shale, clay, organic matter, friable materials, and debris; graded in accordance with ASTM C136 within the following limits:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	75 to 100
1/2 inch	25 to 60
3/8 inch	0 to 5

Use for pipe foundation material and as shown on the Drawings.

B. Pipe Bedding Material – Aggregate Type A2: Angular, crushed stone free of shale, clay, organic matter, friable materials, and debris; graded in accordance with ASTM C136 within the following limits: (Alternative gradations will be considered)

Sieve Size	Percent Passing
3/4 inch	100
1/2 inch	75 to 100
3/8 inch	65 to 85
No. 4	40 to 65
No. 10	25 to 50
No. 50	10 to 25
No. 200	0 to 5

Use for pipe bedding material and as shown on the Drawings.

C. Backfill Material – Aggregate Type A3: Durable material free of shale, clay, organic matter, friable materials, and debris meeting the following limits: (Alternative gradations will be considered)

Sieve Size	Percent Passing
4 inches	100
3 inches	95 to 100
2 inches	75 to 100
1 inch	40 to 80
No. 4	25 to 60
No. 200	5 to 12

Use for trench and structural backfill material, site fill material, and as shown on the Drawings.

D. Untreated Base Course – Aggregate Type A4: Angular, crushed, free of shale, clay, organic matter, friable materials, and debris; graded in accordance with ANSI/ASTM C136, ASTM D2487 Group Symbol GW; within the following limits: (Alternative gradations will be considered)

Sieve Size	Percent Passing
1 inch	100
3/4 inch	80 to 95
1/2 inch	60 to 85
No. 4	41 to 68
No. 10	30 to 47
No. 16	20 to 40
No. 40	10 to 27
No. 200	0 to 5

Use for untreated road base material or structural foundation material and as shown on the Drawings.

E. Free Draining Gravel – Aggregate Type A5: Angular, crushed stone free of shale, clay, organic matter, friable materials, and debris meeting the following limits:

Sieve Size	Percent Passing
1.5 inches	100
1 inch	95 to 100
1/2 inch	25 to 60
No. 4	0 to 5

Use for free draining gravel beneath floor slabs and foundations and as shown on the Drawings.

F. 1” Crushed Gravel Landscape – Aggregate Type A6: Angular, crushed stone free of shale, clay, organic matter, friable materials, and debris meeting the following:

Non-expansive granular soil	
Liquid Limit	<30%

Sieve Size	Percent Passing
1 inch	100
3/4 inch	75 to 100
1/2 inch	0 to 5

Use for free draining gravel beneath floor slabs and foundations and as shown on the Drawings.

2.2 SOURCE QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 01 45 00 – Quality Control.

B. Tests and analysis of aggregate material will be performed in accordance with ASTM C136 and ASTM D2487. A minimum of three (3) tests of each material source must be done.

C. If tests indicate materials do not meet specified requirements, change material and retest at no cost to Owner.

PART 3 EXECUTION

3.1 STOCKPILING

A. Stockpile materials on site.

B. Stockpile in sufficient quantities to meet project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

E. Upon removal, do not mix material with native materials.

3.2 STOCKPILE CLEANUP

A. Remove stockpile, leave area in a clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 33 05 10
PIPE AND PIPE FITTINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. PVC AWWA C900 AND C905 PIPE and Fittings

B. Ductile Iron Pipe and Fittings

C. HDPE Pipe

D. Reinforced Concrete Pipe

E. Corrugated HDPE Pipe

F. Steel Pipe

G. Steel Galvanized Pipe and Fittings

H. Drain Pipe and Appurtenances

I. Couples and Coupling Adapter

J. Sleeves

K. Aggregate

L. Concrete

M. Joint Restraint Glands

N. Bell Restraints

O. Tests

P. Valve Boxes

Q. Pipe Supports

1.2 REFERENCES

A. NSF/ANSI 61 Drinking Water System Components – Health Effects

B. AASHTO M36: CMP, Ribbed Pipe and Pipe Arches.

C. AASHTO M252: Standard Specification for Corrugated Polyethylene Drainage Pipe

D. AASHTO M294: Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter

E. ANSI/AWWA B300: Hypochlorites.

F. ANSI/AWWA B301: Liquid Chlorine.

G. ANSI/AWWA C104: Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

H. ANSI/AWWA C105: Polyethylene Encasement for Ductile-Iron Pipe Systems.

I. ANSI/AWWA C110: Ductile Iron and Gray-Iron Fittings for Water and Other Liquids.

J. ANSI/AWWA C111: Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

K. ANSI/AWWA C115: Flanged Ductile Iron Pipe with Threaded Flanges.

L. ANSI/AWWA C151: Ductile Iron Pipe.

M. ANSI/AWWA C153: Ductile Iron Compact Fittings.

N. ANSI/AWWA C200: Steel Water Pipe.

O. ANSI/AWWA C213: Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.

P. ANSI/AWWA C550: Protective Interior Coatings for Valves and Hydrants.

Q. ANSI/AWWA C600: Installation of Ductile-Iron Water Mains and Their Appurtenances

R. ANSI/AWWA C605: Installation of Polyvinyl Chloride Pressure Pipe and Fittings

S. ANSI/AWWA C651: Disinfection of Water Mains

T. ANSI/AWWA C900: PVC Pressure Pipe for Water Distribution.

U. ANSI/AWWA C905: PVC Pressure Pipe.

V. ANSI/AWWA C906: Polyethylene (PE) Pressure Pipe and Fittings, 4in. Through 63 in. For Water Distribution

W. ANSI/AWWA C907: Polyvinyl Chloride (PVC) Pressure Fittings for Water, 4in. Through 8in.

X. ANSI/AWWA C909: Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4in. Through 12 in., For Water Distribution

Y. ASTM-A120: Pipe, Steel, Black and Hot-dipped Zinc Coated (Galvanized), Welded and Seamless.

Z. ASME B16.3: Malleable Iron Threaded Fittings.

AA. ASTM-A53: Pipe, Steel, Black and Hot Dipped Zinc Coated, Welded and Seamless.

BB. ASTM-C-76: Reinforced Concrete Pipe.

CC. ASTM C-443: Joint for Circular Concrete Sewer and Culvert Pipe using Rubber Gaskets.

DD. ASTM D1785: Polyvinyl Chloride (PVC) Plastic Pipe Schedules 40, 80, and 120.

EE. ASTM-D1787: Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.

FF. ASTM D-3034: PVC Gravity Sewer Pipe and Fittings.

GG. ASTM D-3212: Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

HH. ASTM F-477: Elastomeric Seals for Joining Plastic Pipe

II. ASTM F-2164 Field Leak Testing of Polyethylene (PE) Pressure Piping Systems using Hydrostatic Pressure

JJ. ASTM F-2648: Annular Corrugated Profile Wall Polyethylene Pipe and Fittings for Land Drainage Applications

KK. AWWA M-11: Manual of Water Supply Practices, Steel Pipe Guide for Design and Installation.

1.3 SUBMITTALS

A. Submit Under Provisions of Section 01 33 00 – Submittal Procedures.

B. Submit manufacturer's certification under provisions of Section 01 33 00 – Submittal Procedures that pipe and fittings meet or exceed specified requirements.

C. Submit manufacturer's installation instructions.

D. Submit shop drawings showing accurate dimensions of pipe, valves, fittings, pumps, support system, and appurtenances. Submit calculations verifying that the system can withstand all pipe system forces.

1.4 PROJECT RECORD DOCUMENTS

A. Accurately record actual location of constructed pipe lines in relation to existing permanent benchmarks.

1.5 DELIVERY, STORAGE AND HANDLING

A. Unload, store and load pipe in a manner that prevents shock, damage or excessive exposure to sunlight and weather.

B. Coated pipe shall be shipped on padded bunks with nylon belt tie down strips or padded banding.

PART 2 MATERIALS

2.1 GENERAL

A. Piping material specifications are as described herein. Pressure class rating and pipe stiffness requirements are specified and identified on the plans.

B. Piping materials shall conform with ANSI/NSF Standard 61, Drinking Water System Components – Health Effects.

C. Piping shall be blue in color.

2.2 PVC AWWA C900 AND C905 PIPE

A. Bell and Spigot: PVC pipe conforming to AWWA C900 (4" through 12") and C905 (14" through 48"), push on rubber gasket joint pipe. Pressure class as called for on plans.

B. Mechanical Joint Fitting: Mechanical joint and flange by mechanical joint ductile-iron fittings conforming to ANSI/AWWA C153/A21.53, ductile-iron compact fittings, ANSI/AWWA C110/A21.10 ductile-iron and gray-iron fittings, and ANSI/AWWA C111/A21.11 rubber-gasket joints for ductile-iron and gray-iron pressure pipe and fittings, rated for 150-psi working pressure.

2.3 DUCTILE IRON PIPE AND FITTINGS

A. Bell and Spigot: Ductile iron pipe conforming to ANSI/AWWA C151/A21.51, push-on rubber gasket joint pipe. Ductile iron pipe shall be minimum pressure class 350, and supplied with a lining conforming to the ANSI/AWWA C104/A21.4 cement mortar lining.

B. Flanged DIP and Fittings: Ductile iron pipe spools shall be pressure class 350 ductile iron pipe. Spools shall be manufactured in accordance with ANSI/AWWA C115 with flanges manufactured in accordance with ANSI B16.1 Class 125.

C. "DIP Wall Spools and Sleeves: DIP spools shall conform to ANSI/AWWA C110 and ANSI/AWWA C115 ductile iron with connecting end type as called for on the plans and compatible with connecting piping and valving. Spools and sleeves shall be class pressure 350 and withstand the anticipated bury depths. Wall spools shall incorporate a statically cast seep ring, which is positioned to accommodate cast-in-place concrete placement, as shown on the plans. Minimum laying length shall be 24 inches."

D. Mechanical Joint Fitting: Mechanical joint and flange by mechanical joint ductile-iron fittings conforming to ANSI/AWWA C153/A21.53, ductile-iron compact fittings, ANSI/AWWA C110/A21.10 ductile-iron and gray-iron fittings, and ANSI/AWWA C111/A21.11 rubber-gasket joints for ductile-iron and gray-iron pressure pipe and fittings, rated for 350-psi working pressure.

2.4 HDPE PIPE

A. ANSI/AWWA C906. HDPE shall be Iron Pipe Sized with a Dimension Ration (DR) of 17

B. Joints: Thermal Butt-Fusion. Fusion shall be performed per AWWA C906.

C. Flanges: Flanges shall be in accordance with AWWA C906. Flat faced or raised face to be compatible with connecting piping.

D. Gasket: Sized to match mating flange. Thickness of 1/16 inch.

2.5 REINFORCED CONCRETE PIPE

A. Pipe shall meet requirements of ASTM C-76.

B. Joints shall meet requirements of ASTM C-443.

2.6 CORRUGATED HDPE PIPE

A. Pipe shall have a smooth interior and annular exterior corrugations meeting requirements of AASHTO M252, AASHTO M294, or ASTM F2306

B. Joints shall be watertight meeting requirements of ASTM D3212.

C. Gaskets shall meet the requirements of ASTM F477.

D. Fitting shall meet the requirements of AASHTO M252, AASHTO M294, or ASTM F2306

2.7 STEEL PIPE

A. ANSI/AWWA C200, ASTM A-139, Grade 40 ksi. Wall thickness as shown on the drawings. Pipe manufacturer: Northwest Pipe and Casing Co., or approved equivalent.

B. Joints: Butt-welded. Field welding shall be performed per AWWA C206. Shop welding and fabrication shall conform to AWWA C207.

C. Flanges: Hub style, slip-on in accordance with AWWA C207, Class D. Flat faced or raised face to be compatible with connecting piping.

D. Gasket: Sized to match mating flange. Thickness of 1/16 inch.

E. Coatings and Linings:

1. Interior lining shall consist of 40 mils DFT, (2) coats of coal tar epoxy, “Bitumastic 300 M”, Carboline or approved equal. Exterior coating of above-ground pipe shall conform to Section 09 90 00 – Painting and Coating.

2.8 STEEL GALVANIZED PIPE AND FITTINGS

A. Steel Pipe and Fittings: ASTM A53, Grade B, Type S, Schedule 40, galvanized with threaded joints. Fittings shall be Class 150 galvanized malleable iron, conforming ANSI B16.3.

2.9 DRAIN PIPE AND APPURTENANCES

A. Drain Pipe:
   1. Solid ADS Drain Pipe: N-12, conforming to AASHTO M252, or PVC Schedule 80.

B. Floor Drains:
   1. Floor drains in concrete floors shall be constructed of cast iron and be the size indicated on the Drawings.
   2. Floor drains shall be Z520-Y by Zurn Industries, 32100-AE-81 by Josam Company, Figure 2350 by Jay R Smith Manufacturing, or approved equivalent.

C. Cleanouts:
   1. Cleanouts shall be the same size as the drain pipe and provided as shown on the drawings and shall meet governing plumbing and mechanical code, whichever is more stringent.
   2. For buried cleanouts, provide cast iron or brass clean out plug with no-hub coupling on end of cleanout at surface.

2.10 COUPLES AND COUPLING ADAPTER

A. Couples: Rockwell OMNI Coupling System 413, ROMAC or approved equivalent.

B. Flange Coupling Adapter: Ford FCA, EBAA Iron, Inc. flanged coupling adaptor with restraining lugs or approved equivalent.

2.11 SLEEVES

A. Sleeves are to be MJ long sleeves (dresser type) sized according to pipe as shown in the plans

2.12 AGGREGATE

A. All aggregate for pipe bedding and foundation stabilization shall conform to Sections 32 05 16 – Aggregates for Exterior Improvements and 31 23 17 - Trenching of these Specifications.

2.13 CONCRETE

A. Concrete for thrust blocks shall conform to Section 03 30 00 – Cast-in-Place Concrete of these Specifications.

2.14 JOINT RESTRAINT GLANDS

A. Wedge action MEG-A-LUG joint restraint glands as manufactured by EBAA Iron, Inc., or approved equivalent. Gland shall be rated at 350 psi with 2:1 safety factor. Provide standard corrosion resistant coating per manufacturer.

2.15 BELL RESTRAINTS

A. Split serrated restraint harness (EBBA Iron Series 1500 or 1600) or equivalent for C-900 pipe. Megalug bell restraint harness (EBBA Iron Series 2800) or equivalent for C-905 pipe. Internal restraint rings (Eagle Loc 900) or approved equivalents may also be used upon approval from engineer.

2.16 TESTS

A. Provide compaction testing of trench backfill in accordance with Section 31 23 17 - Trenching.

B. Provide pipe pressure testing in accordance with this Section.

2.17 VALVE BOXES

A. Adjustable cast iron valve boxes and lid, per Owner specifications.

2.18 PIPE SUPPORTS

A. Pipe supports shall be as shown on the Plans.

2.19 PIPE SADDLE TAPS

A. For ductile iron pipe, 2- to 30-inch diameter: Ford Style FC202 with double-wide stainless steel band and fusion epoxy coated body, ROMAC Style 202S, or approved equivalent. 150 psi minimum working pressure. Hardware shall be stainless steel.

B. For PVC, CPVC, or polyethylene pipe, 12-inch diameter and smaller, and for chemical service: Spears Manufacturing Company Schedule 80 Clamp-on Saddles or approved equivalent. O-rings shall be compatible with pipe contents. Hardware shall be stainless steel. 150 psi minimum working pressure. Provide socket or threaded outlet connection as required by connecting pipe system. All components of the saddle shall be compatible with the chemical(s) utilized within the process piping.

C. For PVC pipe, up to 30-in diameter, for non-chemical service: Ford Style FC202 with double-wide stainless steel band and fusion epoxy coated body, ROMAC Style 202S, or approved equivalent. 150 psi minimum working pressure. Hardware shall be stainless steel.

D. For stainless steel pipe, Schedule 10S to Schedule 40: ROMAC Style 306 or approved equivalent. All metal components, including hardware, shall be 304 stainless steel.

Gasket shall be NBR or as required for compatibility with the process liquid. Saddle shall meet the requirements of ANSI/AWWA C800. Minimum working pressure of 150 psi.

2.20 DIELECTRIC UNIONS AND INSULATION FLANGES

A. Dielectric unions or insulating flanges shall be used to separate all dissimilar metal pipe connections and wherever buried ferrous metal pipe transitions to above grade.

2.21 DIAPHRAGM-TYPE COMPRESSION TANK

A. Manufacturers:
   1. Amtrol WX-448C.
   2. Or Approved Equal.

B. Construction:
   1. NSF/ANSI 61 certification and ASME Boiler and pressure vessel code certification
   2. Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1
   3. Rated for minimum working pressure of 125 psig (860 kPa)
   4. Full acceptance, replaceable heavy-duty butyl bladder sealed into tank
   5. Steel legs or base stand for vertical installation
   6. Painted with primer per specification 09 90 00.

C. Accessories: Pressure gage and air-charging fitting, tank drain.

D. Size: 24 inches diameter, 80 gal capacity.

E. Tank Settings:
   1. Cut-in Pressure = 60 psi
   2. Cut-out Pressure = 80 psi
   3. Pre-Charge to 58 psi

PART 3 EXECUTION

3.1 EXAMINATIONS

A. Verify excavation under provisions of Section 31 23 17 - Trenching.

B. Verify that excavation will allow a minimum pipe cover of 60” or as shown on the Plans and described elsewhere in the Specifications. If existing pipelines are less than minimum cover, connect to existing pipeline and angle pipe, as necessary, to achieve cover requirements.

C. Verify that excavations are to required alignment, grades, dry, and not over-excavated.

D. Examine pipe and fittings for defects or damage.

E. Verify all pipe, fittings, aggregate, and all materials delivered to the site meet the requirements of these Technical Specifications.

F. Examine existing piping locations and structures where connections are to be made.

G. Verify equipment locations and make modifications in piping to properly connect to equipment as necessary, prior to fabrication.

3.2 PIPE INSTALLATION

A. Remove all water from excavation.

B. Install pipe in accordance with the manufacturer's recommendations.

C. Utilize proper tools for cutting and beveling pipe ends and joining pipe using manufacturer's recommended tools designed for this task.

D. Clean and prepare pipe joint using manufacturer's recommended gasket and lubricant.

E. Utilize proper tools to complete joint, assuring that plain end is inserted "home" in the bell.

F. Assure that no dirt or other foreign material is allowed in pipeline. Plug all pipe ends with water tight plugs when leaving the pipe unattended.

G. Complete trenching and backfilling for pipelines in accordance with Section 31 23 17 - Trenching.

H. Install pipe fittings so a constant alignment and level grade is achieved through all the pipe and fittings.

I. Install pipelines to the alignments and grades shown on the Drawings.

J. Properly align pipe perforated slots in trench.

K. Anchors and Supports: Install anchors and supports as necessary to properly support pipe against all static, dynamic, and vibratory loads. Contractor shall submit shop drawings and calculations for proposed pipe support system.

L. Install pipe connectors in strict accordance with the recommendation of the connector manufacturer.

3.3 THRUST BLOCKS

A. Place thrust blocks at each elbow, tee, cross, and gate valve installed underground.

B. Provide bearing area against undisturbed earth.

C. Place thrust blocks such that fitting can be removed at a later date without damage to the pipeline.

D. Place 6 mil Visqueen plastic between thrust block and fitting.

E. Place concrete so no concrete touches the nuts and bolts of the fitting or valve, and the nuts and bolts can be removed and replaced without removing any concrete.

F. Thrust Block: Sizes are shown on the plans or in the APWA Specifications.

3.4 FLUSHING

A. All new water systems or extensions to existing systems shall be thoroughly flushed before being placed in service. Flushing shall be accomplished through hydrants, or end of line blow-off assemblies at a minimum flushing velocity of 2.5-feet per second. See chart below.

FLOW RATE AND OPENINGS TO FLUSH PIPELINES (40- psi Residual Pressure)	
Pipe Size (inches)	**Flow Required to Produce 2.5 fps velocity (gpm)**
2	26
4	100
6	220
8	390
10	610
12	880
14	1,200
16	1,565
18	1,980
20	2,450
24	3,525
30	5,507

B. Certify test results meet these specifications for Section 01 33 00 – Submittal Procedures.

3.5 DISINFECTION

A. After flushing, all culinary water lines shall be disinfected by chlorination. Chlorination shall provide a minimum of 25 ppm residual after 24 hours contact in the pipeline. This may be expected with an application of 50 ppm, although some conditions may require more. Chlorine in the form of a 1% slurry of high-test calcium hypochlorite (HTH, Perchloron, Pittchlor, etc. which are 70% available chlorine by weight) shall be fed into the pipeline in such a manner as to mix with the water flowing in the pipeline. (A 1% slurry - 10,000 ppm - results from mixing one pound of calcium hypochlorite with 8.40 gallons of water.) When specifically authorized by the City, chlorine pellets or powder may be used. Rechlorination of pipes will always require a slurry.

B. The following table provides information as to the required quantity of slurry to be used per 100 feet of pipe to provide a chlorine concentration of 50 ppm:

Pipe Size (in.)	Vol. of 100 ft. Length (gal)	Required Amount of 1 % Chlorine Slurry (gal)
1 ½	9.18	0.07
2	16.32	0.12
2 ½	25.50	0.18
3	36.73	0.26
4	65.28	0.47
6	146.90	1.05
8	261.10	1.87
10	408.10	2.92
12	587.60	4.20

C. During the process of chlorinating the pipeline, all valves and other pipeline appurtenances shall be operated several times to provide sufficient contact with the chlorinating agent. Following chlorination, the water line shall be drained and thoroughly flushed according to Section A above and, if necessary, rechlorinated until a satisfactory bacteriological test is obtained.

D. Disinfection shall conform to the requirements of AWWA C651 (latest edition).

3.6 PRESSURE TESTING

A. Pressure testing shall conform to AWWA C600 for Ductile Iron pipe, AWWA C605 for PVC pipe, or for other pipe as follows:

1. All newly laid pipes or any valved section thereof shall be subjected to a hydrostatic pressure. A leakage test shall be conducted concurrently with the pressure test.
2. Test pressures shall not be less than 1.5 times the static pressure at the highest point along the test section.
3. Test pressures shall not exceed pipe or thrust restraint design pressures.
4. Test pressures shall be of at least 2-hour duration.
5. Test pressures shall not vary by more than plus or minus five (+ 5) psi for the duration of the test.
6. Test pressures shall not exceed twice the rated pressure of the valves or hydrants when the pressure boundary of the test section includes closed gate valves or hydrants.
7. Test pressures shall not exceed the rated pressure of the valves when the test boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.
8. Each valved section of pipe shall be slowly filled with water and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gage, shall be applied by

means of a pump connected to the pipe in a manner satisfactory to the Public Works Representative/Engineer.

9. Before applying the specified test pressure, air shall be expelled completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall be closed and the test pressure applied. At the conclusion of the pressure test, the corporation cocks shall be removed and plugged.
10. All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound materials and the test shall be repeated until it is satisfactory to the Owner.

3.7 LEAK TESTING

A. Leak testing shall conform to AWWA C600 for Ductile Iron pipe, AWWA C605 for PVC pipe, or for other pipe as follows:

1. A leakage test shall be conducted concurrently with the pressure test.
2. Leakage shall be defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.
3. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD(P)^{0.5}}{148{,}000}$$

in which L is the allowable leakage, in gallons per hour; S is the length of pipeline tested in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test, in pounds per square inch gage.

4. Allowable leakage at various pressures is shown in the following table:

Allowable Leakage per 1000 ft of Pipeline – gph											
Avg. Test Pressure *psi (Bar)*	Nominal Pipe Diameter (inches)										
	3	4	6	8	10	12	14	16	18	20	24
450 (31)	0.43	0.57	0.86	1.15	1.43	1.72	2.01	2.29	2.58	2.87	3.44
400 (28)	0.41	0.54	0.81	1.08	1.35	1.62	1.89	2.16	2.43	2.70	3.24
350 (24)	0.38	0.51	0.76	1.01	1.26	1.52	1.77	2.02	2.28	2.53	3.03
300 (21)	0.35	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81
275 (19)	0.34	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69
250 (17)	0.32	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56
225 (16)	0.30	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43
200 (14)	0.29	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29
175 (12)	0.27	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15
150 (10)	0.25	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99
125 (9)	0.23	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81
100 (7)	0.20	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62

*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

**To obtain leakage in liters/hour, multiply the values in the table by 3.785.

5. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gal/hr/in. of nominal valve size shall be allowed.
6. When hydrants are in the test section, the test shall be made against the closed hydrant.
7. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe laid discloses leakage greater than specified, the Contractor shall, at its own expense, locate and repair the defective material until the leakage is within the specified allowance.
8. All visible leaks are to be repaired regardless of the amount of leakage.

3.8 CONNECTIONS TO EXISTING MAINS

A. Expose existing main and verify line size and type of pipe.

B. Provide the necessary fittings that comply with these Specifications and connect to the existing main. Properly align pipe to interface with existing pipeline so no unusual stresses are applied to the pipe.

C. Maximum allowable pipe gap at compression couples is one-half (1/2) inch maximum.

END OF SECTION

SECTION 33 12 16
WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Gate Valves

B. Butterfly Valves

C. Pressure Reducing Valves

D. Combination Air Release/Vacuum Valves

E. Isolation Valves

F. Pressure Relief Valves

G. Check Valves

H. Valve Boxes

I. Accessories

1.2 RELATED SECTIONS

A. Section 01 22 00 – Measurement and Payment.

B. Section 01 33 00 – Submittal Procedures.

C. Section 01 40 00 – Quality Requirements.

D. Section 01 70 00 – Execution and Closeout Requirements.

E. Section 33 30 12 – Valve and Gate Actuators

1.3 REFERENCES

A. ANSI B16.1 – Cast Iron Flanges.

B. AWWA C550 – Protective Epoxy Interior Coatings for Valves and Hydrants.

C. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.4 PERFORMANCE REQUIREMENTS

A. Gate and Butterfly Valves: The gate valve shall be designed to isolate flow in differing sections of pipe and seal completely to prevent leakage.

B. Flapper Valves: Restrict backflow through upstream pipe by seating of flapper against pipe end.

C. Pressure Reducing Valves: Shall open when downstream pressure falls below a set level. Setting shall be field adjustable to match application requirements.

D. Combination Air Valves: Shall allow large quantities of air to escape out of the orifice while pipe is filling and to close water tight when liquid enters valve. Valve shall also allow air to enter when pipe is draining to prevent vacuum.

E. Isolation Valves (small diameter): Must be ball type with female threaded ends. Shall provide a fluid tight separation of system components when closed.

1.5 SUBMITTALS

A. Submit shop drawings under provisions of Section 01 33 00.

B. Submit product data under provisions of Section 01 33 00.

C. Submit product data for all valves and associated parts.

D. Submit design data under provisions of Section 01 33 00.

E. Submit manufacturer's certificate under provisions of Section 01 40 00 that products meet or exceed specified requirements, are properly sized and performance is guaranteed by the manufacturer for this application.

F. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

G. Submit manufacturer's field reports under provisions of Section 01 40 00.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with manufacturer's recommendations.

B. Maintain one copy of document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in the manufacturer of products specified in this section with minimum five years documented experience.

1.8 WARRANTY

A. Warranty: Include one (1) year coverage on all valves.

1.9 MAINTENANCE SERVICE

A. Provide operation and maintenance manuals with all valves in accordance with Section 01 70 00, 01 33 00.

PART 2 PRODUCTS

2.1 GENERAL

A. For Potable Water Applications, Valve shall be NSF 61 certified – Lead free.

B. Unless otherwise indicated, provide shut-off and throttling valves and externally actuated valves and gates with manual or power actuators.

C. Provide actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, hand wheels, levers, chains, and extensions, as applicable.

D. Provide actuators with torque ratings equal to or greater than required for valve seating and dynamic torques, whichever is greater, and capable of holding the valve in any intermediate position between fully-open and fully-closed without creeping or fluttering.

E. Actuator torque ratings for butterfly valves shall be determined in accordance with American Water Works Association (AWWA) C504 - Rubber-Seated Butterfly Valves.

F. Identify wires of motor-driven actuators by unique numbers.

G. Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

H. Unless otherwise specified, all interior bronze parts of valves except gate valve stems shall conform to the requirements of the “Specification for Composition Bronze or Ounce Metal Castings,” (ASTM B62). Gate valve stems shall be of bronze containing not more than five percent of zinc nor more than two percent of aluminum, and shall have a minimum tensile strength of 60,000 pounds per square inch (psi), a yield strength of 40,000 psi, and an elongation of at least 10 percent in two inches, as determined by a test coupon poured from the same ladle from which the valve stems to be furnished are poured.

2.2 GATE VALVES

A. Conforms to AWWA C515 with a fusion-bonded epoxy lining and coating conforming to AWWA C515.

B. Resilient wedge gate valve with hand wheel activator for above ground installations and two (2) inch square AWWA operating nut for underground installations. Provide a total of two (2) – six (6) foot long wrench keys for operation of buried valves that are installed for the project. Valve body shall be epoxy coated. For above ground gate valves, supply a 2” AWWA nut adapted hand wheel.

C. The valves shall be non-rising stem. The word “Open” and an arrow cast in the metal must be present to indicate direction to open.

D. The wedge shall be of cast iron completely encapsulated with rubber.

E. The sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond ASTM D429.

F. Stems for NRS assemblies shall be cast bronze with integral collars in full compliance with AWWA. OS & Y stems shall be on bronze bar stock. The NRS stem stuffing box shall be the o-ring seal type with two rings located above thrust collar; the two rings shall be replaceable with valve fully open and subjected to full rated working pressure.

G. There shall be two low torque thrust bearings located above and below the stem collar. The stem nut shall be independent of wedge and shall be made of solid bronze. There shall be a smooth unobstructed waterway free of all pockets, cavities and depressions in the seat area.

H. The body and bonnet shall be coated with a fusion coating both interior and exterior to meet C550. Each valve shall have maker's name, pressure rating and year in which manufactured cast on the body. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to twice the specified working pressure.

I. 3-inch and smaller gate valves shall be brass, rising stem type, with hand wheels.

2.3 BUTTERFLY VALVES

A. High Performance AV-TEK Double Eccentric Butterfly Valve with handwheel and electric motor actuator.

1. Actuator Manufacturer:
    a. 120V ROTORK IQT2000
2. Handwheel Operation
    a. Provide a permanently attached handwheel for emergency manual operation.
    b. The handwheel shall not rotate during electrical operation.
    c. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 pound-foot, and the maximum force required on the rim of the handwheel shall not exceed 60 pounds.
    d. Cast or permanently affix an arrow and either the word "OPEN" or "CLOSE" on the handwheel in order to indicate the appropriate direction to turn the handwheel.
    e. Provide a clutch lever to put the actuator into handwheel operation.
    f. Provide chain activator handwheels for valves with electric motor actuators having stems more than seven feet above the floor.
    g. Provide the clutch lever with a cable secured to the chain in order to allow disengagement for manual operation.

B. Actuator to conform with Section Section 33 30 12 – Valve and Gate Actuators.

C. Conforms to AWWA C504 Rubber-Seated Butterfly Valves with a fusion-bonded epoxy lining and coating conforming to AWWA C515

D. Comply with NSF/ANSI 61 Drinking Water System Components – Health Effects

E. Valve body type, size and quantity shall be as indicated on the Drawings

F. Maximum nonshock shutoff pressure and maximum nonshock line pressure

G. Flow rate required through the valve shall be 1,500 gpm under normal conditions, and 2,500 gpm under maximum flow conditions

H. Connecting pipe material shall be as indication on the Drawings.

2.4 PRESSURE REDUCING VALVE

A. Manufacturer: Cla-Val, or approved equal

B. Catalog Number: 90-01

C. Valve Size: As indicated on plans

D. Pattern: Globe

E. Valve shall be provided with Anti-Cavitation trim.

F. Pressure Class: 150

G. Flow Characteristics:
1. 8-inch; 15 to 3,100 gpm
2. 6-inch; 10 to 1,800 gpm
3. 4-inch; 4 to 800 gpm
4. 3-inch; 2 to 460 gpm

H. Pilot Operational Range: 15 to 75 psi, Ability to adjust pressure drop across valve 20 to 50 psi

I. Valve to be provided with a “pre-strainer” for the pilot tube system, larger than the factory supplied strainer. The large volume strainer shall work in series with the smaller factory strainer. A clear strainer with a perforated mesh area of no less than 15 square inches shall be used ahead of the factory strainer. Strainer shall have a ¼ turn ball valve for flushing. Strainer shall have no less than 100 PSI rating. Non PRV manufacturer supplied strainer to be Action Machining Inc. or equivalent with a perforated #32 mesh.

J. Valve Body & Cover Material: Ductile Iron, epoxy coated

K. Disc Retainer & Diaphragm Washer: Cast Iron

L. Trim & Tubes: Stainless Steel or equivalent.

2.5 WELL SERVICE AIR VALVE

A. Install combination air valves on the piping as indicated in the plans to rid the piping of entrapped air during normal operating conditions and allow air to exit/enter the piping during filling/emptying conditions.

B. The valve(s) within the pump station building, directly downstream of the well pump, shall be Valmatic VM-100ST single body Combination Air Valve, or approved equivalent.

C. Provide an isolation ball valve and all necessary fittings to install the valve at the locations shown in the plans. Install the combination air release/vacuum valve in the location shown on the Drawings.

2.6 COMBINATION AIR RELEASE/VACUUM VALVE

A. Install combination air valves on the piping as indicated in the plans to rid the piping of entrapped air during normal operating conditions and allow air to exit/enter the piping during filling/emptying conditions.

B. The valve(s) within the pump station building shall be ARI D-040 with composite body material or Valmatic Resilite single body Combination Air Valve with thermoplastic body, or approved equivalent.

C. Provide an isolation ball valve and all necessary fittings to install the valve at the locations shown in the plans. Install the combination air release/vacuum valve in the location shown on the Drawings.

2.7 ISOLATION VALVES (LESS THAN 2")

A. Bronze construction 150 psi working pressure. Bronze 1/4 turn type ball valve. Valve shall be Watts B-6000 bronze ball valve or approved equivalent.

B. Valve shall have threaded double-union body that can be removed from the line without disengaging the end connections

2.8 PRESSURE RELIEF VALVE

A. Manufacturer: Cla-Val, or approved equal

B. Catalog Number: 50-01

C. Valve Size: As indicated on plans

D. Pattern: Globe

E. Valve shall be provided with Anti-Cavitation trim.

F. Pressure Class: 150

G. Flow Characteristics:

1. 6-inch; 1,800 to 4,000 gpm

H. CRL Adjustment Range: 100 to 300 psi.

I. Valve Body & Cover Material: Ductile Iron, epoxy coated

J. Disc Retainer & Diaphragm Washer: Cast Iron

K. Trim & Tubes: Stainless Steel or equivalent.

2.9 CHECK VALVES

A. For water service check valves > 4”: Swing check valves shall be swing-type, lever and weight operated check valves. The valve shall have a cast iron body and disc with a rubber to metal seat configuration to seal valve with low pressure differential. The valve shall have a bronze seat, rubber seat ring and 303 stainless steel shaft. The external lever shall have an adjustable weight to assist the disc. Swing check valves shall be Mueller, Crane, Ludlow, Cla Val, or equivalent.

2.10 VALVE BOXES

A. 12-inch diameter Valves and Smaller: Domestic cast iron, two-piece.

B. Cast iron lid, marked with appropriate utility designation: eg. "Irrigation", “Water”, Sewer”.

2.11 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type specified in Section 03 30 00.

B. Aggregate: Aggregate for hydrant drainage specified in Section 31 05 16.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify all valve components are operable and present.

B. Verify all pipe components are ready to receive valves.

C. Verify field measurements are as shown on shop drawings.

3.2 INSTALLATION

A. Install valves in accordance with manufacturer's recommendations.

B. Install buried valves so the two (2) inch operating nut is plumb and centered in the valve box. Ensure no debris is present to hinder or prevent valve operation. Prevent valve box from transmitting loads or shock to the valve.

C. Install all valves so a watertight seal is provided at joints.

D. Center and plumb valve stem over valve.

3.3 DEMONSTRATION

A. Demonstrate valve operation, adjustments, and maintenance.

B. Demonstrate valve function within specified requirements.

END OF SECTION

SECTION 33 12 20
WATER UTILITY DISTRIBUTION PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Vertical turbine submersible multistage centrifugal pump and motor

1.2 RELATED SECTIONS

A. Section 01 22 00 – Measurement and Payment

B. Section 01 33 00 – Submittal Procedures

C. Section 01 40 00 – Quality Requirements

D. Section 01 70 00 – Execution and Closeout Requirements

E. Section 33 11 16 – Water Utility Distribution Piping

F. Division 26 – Electrical

1.3 REFERENCES

A. AWWA Standard E102 – Submersible Vertical Turbine Pumps

B. AWWA Standard C110 – Ductile Iron and Gray-Iron Fittings for Water

C. ANME/ANSI B16.5 – Pipe Flanges and Flanged Fittings

D. NEMA MG-1 Motor and Generators

E. ANSI/HI 9.6.4 Rotodynamic Pumps for Vibration Measurements and Allowable Values

F. ANSI/HI 9.8 Pump Intake Design

G. ANSI/HI 14.6 Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements and are suitable for the intended use.

C. Submit pump and motor performance and nameplate data, pump curves showing operating points with impeller trim, NPSH curve, submergence requirements, bhp, efficiencies, gravitational weight of the rotating parts, hydraulic down thrust during

normal operation and at shut-off head, type and size of motor, size and dimensions of suction intake, lineshaft sizing calculations, and bearing life calculations.

D. Submit pump and motor manufacturer and model number, number of pump stages, pump and motor size and dimensioning data, and motor protection and efficiency.

E. Submit certified pump curve associated with a factory non-witness performance test showing that performance requirements are satisfied. Curves shall include flow, head, efficiency, net positive suction head (NPSH) required and brake horsepower. The curve from the performance test shall be approved by the Engineer prior to shipment. Certify that pump will perform in accordance with the submitted curve and data. The pump test acceptance grade shall be 1E as described in Table 14.6.3.4 of ANSI/HI 14.6-2011 Rotodynamic Pumps for Hydraulic Performance Acceptance Tests. The guarantee requirements for the test parameters, rate of flow and total head, are mandatory in ANSI/HI 14.6 Table 14.6.3.4 while power or efficiency are optional. Efficiency as a guarantee requirement at the same acceptance grade is hereby expressly required for this project.

F. Submit a copy of this specification section, with addendum updates included, with each paragraph clearly marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. If deviations from the specifications are indicated and, therefore requested by the Contractor, the submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification for any requested deviations to the specification requirements, with the submittal shall be cause for rejection of the entire submittal with no further consideration. The Owner retains the right to reject any proposed deviations in favor of this specification as written.

1.5 QUALITY ASSURANCE

A. Manufacturer: Company specializing in the manufacturing of the pumps and motors specified in this section, with a minimum of ten (10) years documented experience.

B. Install and operate pumps and motors in accordance with the manufacturer's recommendations.

C. Manufacturer will provide a factory trained representative to inspect and certify the installation and oversee the startup of the pumping equipment.

D. Manufacturer: Provide vertical turbine and vertical in-line multistage pumps and motors meeting the requirements of this specification from one of the following, or an equal pre-approved prior to bid opening:

1. Vertical Turbine

    a. Flowserve Corporation
    b. National Pump
    c. Peerless Pump

d. Simflo Pump
e. Xylem Goulds Pump

2. Vertical in-line multistage

a. Grundfos

1.6 WARRANTY

A. Warranty: Include coverage of all pump and motor system including but not limited to pump, motor, impellers, bearings, seals, wear plates, wear rings, and pump and motor shafts for a period of one (1) years from the date of the final pay request. Warranty shall cover any problems created from vibration, manufacturing defects, improper installation, or other defective work.

1.7 PERFORMANCE REQUIREMENTS

A. Submit under provisions of Section 01 33 00.

B. Vertical Turbine Well Pump and Motor.

1. Design Point

Design flow capacity, gpm	1,500
Total Dynamic Head (TDH), ft	375
Minimum shut off head, ft	700
Maximum NPSH (absolute) required at design point, ft	N/A
Minimum pump efficiency, %	77.5
Maximum nominal pump speed, rpm	1,800
Number of pump stages	12 - 14
Maximum motor size, BHP	200

2. Pump Dimensions

Approximate Setting Depth (from flange of discharge head to end of suction strainer), TPL, ft	406
Minimum column diameter, in.	8

Min. wall thickness of steel column pipe, in.	0.37
Discharge flange size, in.	10
Discharge flange rating ANSI	150#
Minimum line shaft diameter, in.	1.5
Maximum bowl diameter, in.	9.5

3. Operating Conditions

Operational Design	Variable speed
Ambient environment	Indoors, ventilated and heated (40°F – 104°F)
Fluid service	Culinary water
Fluid temperature, degrees F	45 to 65
Project site elevation	4603 ft

C. Vertical In-Line Multistage Pump and Motor – Chlorine Booster

1. Grundfos CR 1-7, or pre-approved equal
2. Design Point

Design flow capacity, gpm	9
Total Dynamic Head (TDH), ft	155
Minimum shut off head, ft	200
Maximum NPSH (absolute) required at design point, ft	5
Minimum pump efficiency, %	47
Maximum nominal pump speed, rpm	3600

Number of pump stages	6 - 8
Maximum motor size, BHP	1

3. Operating Conditions

Operational Design	Constant speed
Ambient environment	Indoors, ventilated and heated (40°F – 104°F)
Fluid service	Culinary water
Fluid temperature, degrees F	45 to 65
Project site elevation	4603 ft

D. Vertical In-Line Multistage Pump and Motor – Well Pre-Lube Booster

1. Grundfos CR 3-7, or pre-approved equal
2. Design Point

Design flow capacity, gpm	16
Total Dynamic Head (TDH), ft	160
Minimum shut off head, ft	220
Maximum NPSH (absolute) required at design point, ft	7
Minimum pump efficiency, %	60
Maximum nominal pump speed, rpm	3600
Number of pump stages	6 - 8
Maximum motor size, BHP	1.5

3. Operating Conditions

Operational Design	Constant speed
Ambient environment	Indoors, ventilated and heated (40°F – 104°F)
Fluid service	Culinary water
Fluid temperature, degrees F	45 to 65
Project site elevation	4603 ft

PART 2 PRODUCTS

2.1 VERTICAL TURBINE WELL PUMP AND MOTOR

A. Vertical turbine pump. Water lubricated, open line shaft, with multistage bowl assembly, column, lineshaft, top shaft, suction screen, fabricated steel discharge head and driver as specified. Unless otherwise stated herein, the pump shall in all respects conform to AWWA Standard E103 – Horizontal and Vertical Line Shaft Pumps and shall comply with all local and state safety regulations. The pump shall meet the requirements of NSF/ANSI 61.

1. Manufacturers of pumps suitable for municipal, drinking water deep well applications must meet the performance requirements stated above and are also subject to the requirements listed below. Manufacturers and models meeting the requirements of this specification may be considered with proper documentation.

2. Discharge head

   a. Constructed of fabricated steel and be of the high-profile type to allow the shaft to be coupled above the stuffing box and be suitable for mounting the motor and supporting the column and bowl assemblies.
   b. Capable of containing the greater of 150% of the maximum pressure developed by the pump as described below, and of sufficient design to support the entire weight of the pump components and driver.
   c. Pumps shall have an above ground 150 #, ANSI B16.5 flanged outlet with diameters as shown in 1.7 B, C and D.
   d. Shall have a 1/2" NPT connection for a pressure gauge.
   e. Outside and inside surfaces of the discharge head shall be coated with Tnemec 141, NSF 61 approved epoxy coating to a minimum 16 mills or approved equal.
   f. A soleplate shall be provided with proper thickness for load and thrust, but no less than 1” with a bolt hole pattern matching the discharge

head. The soleplate shall be epoxy coated with Tnemec 141, NSF 61 approved epoxy coating to a minimum 16 mills or approved equal.

g. Equipped with integral lifting lugs to facilitate installation and removal. Capable of withstanding the weight of the discharge head and pump assembly.
h. A tapped drain line shall be provided to convey packing discharge to the floor drain. Access ports shall be provided as shown on the drawings.
i. A pre-lube system shall be provided complete with solenoid valve, flow meter, flow switch, tubing, connection to mechanical piping and interconnect to the motor control panel to lubricate the line shaft bearings prior to each pump operation cycle.
j. Discharge head shall be provided with (2) 1" diameter NPT ports.

3. Top line shaft

a. The top line shaft (head shaft) shall be of ASTM A582 Type 416 stainless steel and have a surface finish not to exceed RMS 40 (ANSI B46.1) and shall not exceed 10 feet in length.
b. The diameter of the shaft and coupling shall be designed in accordance with AWWA E103 Section 4.4.2.2 with a shaft speed of one half of the nominal pump speed. To ensure accurate alignment of the shafts, they shall be straight within 0.005 in. total indicator reading for a 10 ft section; the butting faces shall be machined square to the axis of the shaft.
c. The top shaft adjusting nut shall be bronze of ASTM B584 and shall be positively locked in position with a steel lock screw or washer of ASTM A108 Grade 1018. Each joint shall be equipped with a Type 304 stainless steel sleeve placed between the bearing and the shafting.

4. Column line shaft

a. Shall be of ASTM A582 Type 416 stainless steel ground and polished to a surface finish not to exceed RMS 40 (ANSI B46.1).
b. Sections shall be furnished in interchangeable sections not over 10 feet in length.
c. The butting faces shall be machined square to the axis of the shaft, with maximum permissible axial misalignment of the thread axis with the shaft axis of 0.002" in 6".
d. Diameter shall be no less than that determined by AWWA E103 Section 4.4.2.2 with a shaft speed of one half of the nominal pump speed. The pump supplier shall confirm that this diameter is such that elongation due to hydraulic thrust will not exceed the axial clearance of the impellers in the pump bowls and meets the AWWA E103 and reduced speed requirements above.
e. Shall be straight within 0.005 in. total indicator reading for a 10 ft. section.
f. The line shaft bearings shall be fluted rubber retained in the centering spider by a shoulder on each end of the bearing.

5. Discharge column pipe

a. Shall be of threaded ASTM A53 grade B steel pipe in interchangeable sections not over 10’ in length for the well pump and not over 5’ in length for the can pumps and shall conform to AWWA E103 Section 4.4.2.
b. Discharge column pipe shall be epoxy coated with Tnemec 21, NSF 61 approved epoxy coating to a minimum 16 mills or approved equal.
c. Sections shall be connected by threaded sleeve couplings.

6. Bowl assembly

a. The pump bowls shall be of close grain, cast ASTM A48 Class 30 or ductile iron ASTM A536, free from blow holes, sand holes and all faults, accurately machined and fitted to close dimensions.
b. The pump bowls shall be capable of withstanding the greater of a hydrostatic pressure equal to twice the pressure at rated flow or 1.5 times the shut-off head.
c. The pump bowls exterior shall be epoxy coated with Tnemec 21, NSF 61 approved epoxy coating to a minimum 16 mills or approved equal.

7. Suction bowl

a. Suction bowl or suction bell shall be provided with a non-soluble grease packed bronze bearing. A bronze sand collar shall be provided to protect this bearing from abrasives in the pumping fluids. The bearing housing shall have sufficient opening at the bottom for easy removal of the bearing.

8. Impellers

a. Shall be cast bronze and shall be the enclosed type with 416 stainless steel collets.
b. The impellers shall be accurately fitted and balanced both statically and dynamically.
c. Factory trimmed to match the performance conditions indicated.
d. Impellers to be secured to the drive shaft by taper locks or collets.

9. Bowl assembly shaft

a. Shall be of A582 Type 416 stainless steel, turned, ground and polished to a surface finish not to exceed RMS 40 (ANSI B46.1).
b. Supported by steel backed rubber bearings above and below each impeller.
c. The suction case bearing shall be grease lubricated and protected by a bronze sand collar of ASTM B584.
d. The size of the shaft shall be no less than that determined by AWWA E103 Section 4.4.2.2.

10. Deep well pump suction strainer

a. Constructed of 316 stainless steel and shall have a net inlet area equal to at least three times the impeller inlet area. The maximum unit opening shall not be more than 75 percent of the minimum opening of the water passage through the bowl or impeller.

11. Sounding tube

    a. The pump column shall be provided with a slotted or perforated 0.75" inch diameter Sch 40 PVC pipe of sufficient length to extend from the well casing sole plate to the top of the bowl assembly to serve as a water level sounding tube. The pressure transducer will be installed during the construction of the well house.

12. Pressure transducer – see electrical specifications

B. Motor

1. WP-1 weather protected, vertical hollow shaft, inverter duty, manufactured by U.S. Motors, or approved equal with all materials, workmanship, and tests conforming with the applicable specifications of the National Electric Manufacturer's Association (NEMA), the Institute of Electrical and Electronic Engineers (IEEE), the American Standards Association (ASA), the Anti-Friction Bearing Manufacturing Association (AFBMA).
2. The following requirements as defined by NEMA MG-1

    a. Premium Efficiency – minimum nominal full load efficiency shall be

        i. 95.8%

    b. Design B
    c. Code F or G

3. Inverter Duty

    a. Name plated for 60 hertz operation. The motor shall be capable of operating a variable torque load over a 2:1 speed range. The motor shall be capable of operating continuously at 30 hertz without overheating.

4. Performance data for adjustable speed operation shall be stamped on a steel data plate permanently attached to the motor frame. The minimum amount of adjustable speed data shall include

    a. Application type: constant torque, variable torque, or constant hp
    b. Maximum approved continuous torque
    c. Approved rpm and frequency operating ranges
    d. Load amps at peak load on inverter power
    e. Service factors

5. Horsepower: The motor shall be altitude compensated to 4,600 feet ASL. The pump horsepower shall not exceed the motor horsepower rating at any point on the pump curve. Anticipated size for the applications is shown in 1.7 B, C and D.
6. Time rating: Continuous, Inverter
7. Maximum ambient temperature: 40°C,
8. Temperature rise: Class B
9. Insulation system designation: Class F, H, or as necessary to meet 2.1.B.3 and 2.1.B.7.
10. Synchronous speed: 1800 rpm

11. Frequency: 60 hz
12. Phases: 3
13. Voltage: 480
14. Service Factor: 1.15
15. Backspin protection: non-reverse ratchet (ball bearing type)
16. Winding heater: 120 VAC
17. Winding thermostat: Over temperature switch
18. Motor bearings
    a. Shall be antifriction and designed to carry the weight of all rotating parts plus the maximum hydraulic thrust load under all conditions of operation.
    b. L-10 life at the operating point shall be a minimum of 44,000 hours with thrust calculated at the pump design point head.
    c. Upper and lower bearings shall be insulated.
19. The motor shall be equipped with a shaft grounding system equal to Aegis SGR.

C. Factory Testing: A Certified Non-Witness Factory Performance Test will be performed on each unit, the performance will include measuring flow and head at rated design condition, testing may be at a reduced speed measuring flow and head corresponding to the rated condition when adjusting for speed using the appropriate affinity laws. Use of a test diver is permitted for factory tests. Record measured flow, suction pressure, discharge pressure and make observations on bearing temperatures and noise level. Pump shipment shall be held until testing results have been reviewed and approved by Engineer.

2.2 VERTICAL INLINE MULTISTAGEPUMP AND MOTOR

A. Chlorine booster and pre-lube booster
1. Vertical inline multistage booster pumps. The pump shall meet the requirements of NSF/ANSI 61.

2. Grundfos CR series, or pre-approved equal

3. Motor
    a. Grundfos ML, TEFC
    b. 3-phase, 208-230/460 VAC
    c. Class F insulation

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify all pumps, motors, and materials are present and meet the requirements of the Specifications.

3.2 INSTALLATION

A. Install pumps, motors, and materials in accordance with shop drawings and manufacturer's recommendations.

B. Install electrical and pump controls in accordance with the manufacturer's recommendations and Division 26 - Electrical of these Technical Specifications.

C. Test installation per section 01 70 00 – Execution and Closeout Requirements.

3.3 STARTUP SERVICES

A. The Contractor shall start the system to ensure that all aspects of the system are operating according to manufacturer's recommendations. The Contractor shall check the volume and pressure capacities of the pumping equipment and submit to Engineer.

B. Provide a factory-trained representative to inspect and to certify the installation of pump and motor. Prior to operator training, demonstrate to the Engineer that the equipment is ready for operation.

C. Provide a factory-trained representative to oversee start-up and demonstrate operation and maintenance of the pump and motor for a minimum of 8 hours at the project site and make necessary adjustments to pump setting, lateral impeller clearances, etc. to provide proper system operation.

D. Prior to owner acceptance and formal pump station start-up, all equipment shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a function test. A start up report showing function testing, motor voltages, running amperages and well water levels shall be provided to the engineer after pump station start-up.

E. Provide four (4) copies of Equipment Operation and Maintenance Manuals to the Engineer.

END OF SECTION

SECTION 33 13 00
DISINFECTION OF WATER DISTRIBUTION AND STORAGE SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Disinfection of potable water storage tank and transmission system.

B. Testing and reporting results.

1.2 REFERENCES

A. Utah Administrative Rule – R309-210: Drinking Water Storage Tanks

B. ANSI/AWWA B300 - Standard for Hypochlorites (latest edition).

C. ANSI/AWWA B301 - Standard for Liquid Chlorine (latest edition).

D. ANSI/AWWA C651 - Standards for Disinfecting Water Mains (latest edition).

E. ANSI/AWWA C652 - Standards for Disinfecting Water Storage Facilities (latest edition).

F. NSF/ANSI 60 – Drinking Water Treatment Chemicals.

1.3 SUBMITTALS

A. Test Reports: Indicate results comparative to specified requirements.

B. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01 77 00 – Closeout Procedures.

B. Disinfection report; record:
1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
5. Date and time of flushing start and completion.
6. Disinfectant residual after flushing in ppm for each outlet tested.
7. Engineer's signature that test was performed with Engineer present.

C. Bacteriological report; record:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Certification that water conforms, or fails to conform, to bacterial standards of State of Utah.
8. Bacteriologist's signature and authority.
9. Engineers signature that test was performed with Engineer present.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance Utah Administrative Rule – R309-210 and AWWA Section C652.

1.6 REGULATORY REQUIREMENTS

A. Conform to Utah Administrative Rule – R309-210, and AWWA C652 or AWWA C651.

PART 2 PRODUCTS

2.1 DISINFECTION CHEMICALS

A. All disinfection chemicals shall conform to NSF 60.

B. Pipeline Chemicals: ANSI/AWWA B300, Hypochlorite, ANSI/AWWA B301, and Liquid Chlorine.

C. Water Storage Tank Chemicals:
1. Liquid Chlorine as specified in Section 3.1 of AWWA C652.
2. Sodium hypochlorite as specified in Section 3.2 of AWWA C652.
3. Calcium hypochlorite as specified in Section 3.3 of AWWA C652.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping system and water storage tanks have been cleaned, pressure washed, reviewed, and pressure tested.

B. Perform scheduling and disinfection activity with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

C. Notify engineer 24 hours minimum prior to conducting test.

3.2 EXECUTION - PIPELINES

A. Provide and attach required equipment to perform the work required of this Section.

B. Introduce treatment into piping system.

C. Maintain disinfectant in system for required period at required concentration in accordance with ANSI/AWWA C651.

D. Flush, circulate and clean until required cleanliness is achieved; use potable domestic water.

E. Replace permanent system devices removed for disinfection.

F. Flush and disinfect pumping equipment prior to final acceptance.

3.3 EXECUTION – WATER STORAGE TANK

A. The tank structure shall be disinfected at the time of testing by chlorination in accordance with AWWA Specification C652 “Disinfection of Water Storage Facilities” most current requirements.

B. All scaffolding, planks, tools, rags, and other materials not part of structural or operating facilities of the tanks shall be removed. Then the surfaces of the walls, floor, and operating facilities of the storage facility shall be cleaned thoroughly using a high pressure water jet. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the storage facility, or otherwise removed.

C. Following the cleaning operation, the vent screen, overflow screen, and other screened openings shall be checked and put in satisfactory condition to prevent birds, insects, and other possible contaminants from entering the facility.

D. Alternative Methods of Chlorination. Three methods of chlorination are explained in AWWA C652. Typically, only one method will be used for a given storage-facility disinfection, but combinations of the methods may be used. The three methods are (1) chlorination of the full storage facility such that, at the end of the appropriate retention period, the water will have a free chlorine residual of not less than 10 mg/L; (2) spraying or painting of all storage facility water-contact surfaces with a solution of 200-mg/L available chlorine; and (3) chlorination of full storage facility with water having a free chlorine residual of 2 mg/L after 24 h. Typically, method 2 and 3 would be used.

E. Chlorination Method #2

1. A solution of 200-mg/L available chlorine shall be applied directly to all interior surfaces of the storage facility.
2. Method of Application. The chlorine solution may be applied with suitable spray equipment. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping, and shall be applied to any separate drain piping such that it will have available chlorine of not less than 10 mg/L when filled with water. Interior of overflow piping need not be disinfected.

3. Retention. The disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30 minutes after which potable water shall be admitted, the drain piping purged of the 10-mg/L chlorinated water, and the storage facility then filled to its overflow level. Following this procedure, and subject to satisfactory bacteriological testing and acceptable aesthetic quality, such water may be delivered to the distribution system at the rate determined by the Engineer.
4. Contractor shall provide all application and safety equipment necessary for application of disinfectant in accordance with OSHA requirements.

F. Chlorination Method #3

1. A solution of 200-mg/L available chlorine shall be applied directly to all interior surfaces of the storage facility.
2. Water and chlorine shall be added to the storage facility in amounts such that the solution will initially contain 50 mg/L available chlorine will fill approximately 5 percent of the total storage volume. This solution shall be held in the storage facility for a period of not less than 6 hr. The storage facility shall then be filled to the overflow level by flowing potable water into the highly chlorinated water. It shall be held full for a period of not less than 24 hr. All highly chlorinated water shall then be purged from the drain piping. Following this procedure and subject to satisfactory bacteriological testing and acceptable aesthetic quality, the remaining water may be delivered to the distribution system.
3. Chlorine shall be added to the storage facility by the method described. The actual volume of the 50-mg/L chlorine solution shall be such that, after the solution is mixed with filling water and the storage facility is held full for 24 hr, there will be a free-chlorine residual of not less than 2 mg/L.
4. Sodium hypochlorite shall be added to the water entering the storage facility by means of a chemical-feed pump or shall be applied by hand-pouring into the storage facility and allowing the inflowing water to provide the desired mixing.
5. When the sodium hypochlorite is poured into the storage facility, the filling of the storage facility shall begin immediately thereafter or as soon as any removed manhole covers can be closed. The sodium hypochlorite may be poured through the cleanout or inspection manhole in the lower course or level of the storage facility, in the riser pipe of an elevated tank, or through the roof manhole. The sodium hypochlorite shall be poured into the water in the storage facility when the water is not more than 3 ft. (0.9 m) in depth, nor less than 1 ft. (0.3 m) in depth or as close thereto as manhole locations permit.
6. Calcium hypochlorite granules or tablets broken or crushed to sizes not larger than 1/4-in. (6.4 mm) maximum dimension may be poured or carried into the storage facility through the cleanout or inspection manhole in the lower course or level of the storage facility, into the riser pipe of an elevated tank, or through the roof manhole. The granules or tablet particles shall be placed in the storage facility before flowing water into it. The granules or tablets shall be located so that the inflowing water will ensure a current of water circulating through the calcium hypochlorite, dissolving it during the filling operation. The calcium

hypochlorite shall be placed only on dry surfaces unless adequate precautions are taken to provide ventilation or protective breathing equipment.

7. Contractor shall provide all application and safety equipment necessary for application of disinfectant in accordance with OSHA requirements.

3.4 QUALITY CONTROL

A. Provide testing of treated water under provisions of Section 01 45 00 – Quality Control.

B. Test pipeline samples in accordance with ANSI/AWWA C651.

C. Test procedure for water storage tank.

1. After the chlorination procedure is completed, and before the storage facility is placed in service, water from the full facility shall be sampled and tested for coliform organisms in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique.
2. Test for odor. The water in the full facility should also be tested to assure that no offensive odor exists due to chlorine reactions or excess chlorine residual.
3. Results of Testing. If the test for coliform organisms is negative, then the storage facility may be placed in service. If the test shows the presence of coliform bacteria, then the situation shall be evaluated by a qualified engineer. In any event, repeat samples shall be taken until two consecutive samples are negative, or the storage facility shall again be subject to disinfection.
4. Care in sampling. The samples shall be taken from a sample tap and outlet piping from the storage facility or from a sample tap connected directly to the storage facility. In either case, the operation shall be such as to ensure that the sample collected is actually from water that has been in the storage facility.
5. Recommended additional samples. During the disinfection operation and the required sampling of water from the storage facility, it is recommended that samples be taken from water inflowing to the storage facility to determine if any forms are present in the typical potable water source.

END OF SECTION

SECTION 33 30 12
VALVE AND GATE ACTUATORS

PART 1 -- GENERAL

1.01 THE SUMMARY

A. Provide valve and gate actuators and appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. The provisions of this Section apply to valves and gates except where otherwise indicated in the Contract Documents.

C. Unit Responsibility

1. Make the valve or gate manufacturer responsible for the coordination of design, assembly, testing, and installation of actuators on the valves and gates; however, the Contractor shall be responsible to the Owner for compliance of the valves, gates, and actuators with the Contract Documents.

D. Where two or more valve or gate actuators of the same type or size are required, the actuators shall be produced by the same manufacturer.

E. The requirements of Division 26 apply to the Work of this Section.

1.02 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Submittal Procedures and Section 33 12 16 – Hydraulic Process Valves.

B. Submit Shop Drawing information for actuators with the valve and gate submittals as a complete package.

C. Submit calculations showing dynamic seating and unseating torques versus the output torque of the actuator.

PART 2 -- PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, provide shut-off and throttling valves and externally actuated valves and gates with manual or power actuators.

B. Provide actuators complete and operable with mounting hardware, motors, gears, controls, wiring, solenoids, hand wheels, levers, chains, and extensions, as applicable.

C. Provide actuators with torque ratings equal to or greater than required for valve seating and dynamic torques, whichever is greater, and capable of holding the valve in any

intermediate position between fully-open and fully-closed without creeping or fluttering.

D. Actuator torque ratings for butterfly valves shall be determined in accordance with American Water Works Association (AWWA) C504 - Rubber-Seated Butterfly Valves.

E. Identify wires of motor-driven actuators by unique numbers.

F. Manufacturers

1. Where indicated, certain valves and gates may be provided with actuators manufactured by the valve or gate manufacturer.

2. Where actuators are furnished by different manufacturers, coordinate the selection to result in the fewest number of manufacturers possible.

G. Materials

1. Provide actuators of current models, of the best commercial quality materials, and liberally sized for the required torque.

2. Provide materials suitable for the environment in which the valve or gate is to be installed.

H. Actuator Mounting and Position Indicators

1. Securely mount actuators by means of brackets or hardware specially designed and sized for this purpose and of ample strength.

2. Cast the word "OPEN" on each valve or actuator, with an arrow indicating the direction to open in the counterclockwise direction.

3. Equip gear and power actuators with position indicators.

4. Where possible, locate manual actuators between 48 and 60 inches above the floor or the permanent working platform.

I. Standards

1. Unless otherwise indicated and where applicable, provide actuators in accordance with AWWA C 542 - Electric Motor Actuators for Valves and Slide Gates.

J. Functionality

1. Coordinate electric, pneumatic, and hydraulic actuators with the power requirements of Division 26 – Electrical, and instrumentation equipment as indicated in Section 40 91 00 – Process Control and Instrumentation Systems.

K. Provide fasteners in accordance with the requirements of Section 05 50 00 – Metal Fabrications.

L. Provide coatings in accordance with the requirements of Section 09 90 00 – High Performance Coatings.

2.02 MANUAL ACTUATORS

A. General

1. Unless otherwise indicated, provide valves and gates with manual actuators.
2. Provide valves in sizes up to and including four inches with direct-acting lever or hand wheel actuators of the manufacturer's best standard design.
3. Provide valves and gates larger than 4-inch with gear-assisted manual actuators, with an operating pull of maximum 60 pounds on the rim of the hand wheel.
4. Provide buried and submerged gear-assisted valves, gates, gear-assisted valves for pressures higher than 250 pounds per square inch gauge (psig), valves 30-inches in diameter and larger, and where indicated, with worm gear actuators, hermetically-sealed water-tight and grease-packed.
5. Valves 6-inch to 24-inch diameter may be provided with traveling-nut actuators, worm gear actuators, spur or bevel gear actuators, as appropriate for each valve.

B. Buried Valves

1. Unless otherwise indicated, provide buried valves with extension stems to grade, with square nuts or floor stands, position indicators, and cast-iron or steel pipe extensions with valve boxes, covers, and operating keys.
2. Where indicated, provide buried valves in cast-iron, concrete, or similar valve boxes with covers of ample size in order to allow operation of the valve actuators.
3. Permanently label the valve box covers as required by the local Utility Company or the Engineer.
4. Provide wrench-nuts in compliance with AWWA C 500 - Metal-Seated Gate Valves for Water Supply Service.

C. Chain Actuator

1. Provide manually-activated valves with the stem located more than seven feet above the floor or operating level with chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains supplied by the valve manufacturer.
2. Construct the wheel and guide from ductile iron, cast iron, or steel.
3. Chains
    a. Fabricate the chain from hot-dip galvanized steel or stainless steel, and extend to five feet six inches above the operating floor level.
    b. Provide an extra strong valve stem on chain-actuated valves in order to allow for the extra weight and chain pull.
    c. Provide hooks for chain storage where chains interfere with pedestrian traffic.

D. Floor Boxes

1. Provide hot-dipped galvanized cast iron or steel floor boxes and covers to fit the slab thickness, for operating nuts in or below concrete slabs.

2. For operating nuts in the concrete slab, provide a bronze-bushed cover.

E. Tee Wrenches

1. Furnish buried valves with floor boxes with 2 operating keys or one key per 10 valves, whichever is greater.

2. Size the tee wrenches such that the tee handle will be 2 to 4 feet above ground, and to fit the operating nuts.

F. Manual Worm Gear Actuator

1. Provide an actuator consisting of a single- or double-reduction gear unit contained in a weatherproof cast iron or steel body with cover, and a minimum 12-inch diameter handwheel.

2. Provide the actuator to be capable of a 90-degree rotation, and equip the actuator with travel stops capable of limiting the valve opening and closing.

3. Provide the actuator with spur or helical gears and worm gearing.

4. Provide a self-locking gear ratio in order to prevent "back-driving."

5. Construct the spur or helical gears of hardened alloy steel, and the worm gear of alloy bronze.

6. Construct the worm gear shaft and the hand wheel shaft from 17-4 PH or similar stainless steel.

7. Accurately cut gearing with hobbing machines.

8. Use ball or roller bearings throughout.

9. Provide the output shaft end with a spline in order to allow adjustable alignment.

10. Actuator output gear changes shall be mechanically possible by simply changing the exposed or helical gearset ratio without further disassembly of the actuator.

11. Design gearing for a 100 percent overload.

12. The entire gear assembly shall be sealed weatherproof.

G. Design and rate buried gear actuators for buried service, provide with a stainless steel input shaft, and double-seal on shaft and top cap.

H. Traveling-Nut Actuator

1. Provide the actuator with a traveling-nut and screw (Scotch yoke), contained in a weatherproof cast iron or steel housing with a spur gear and a minimum 12-inch diameter hand wheel.

2. The screw shall run in two end bearings, and provide a self-locking actuator in order to maintain the valve position under any flow condition.

3. Construct the screw and gear from hardened alloy steel or stainless steel, and the construct the nut and bushings from alloy bronze.

4. The bearings and gear shall be grease-lubricated by means of nipples.

5. Design gearing for a 100 percent overload.

2.03 ELECTRIC MOTOR ACTUATORS

A. General

1. Equipment Requirements

a. Where electric motor actuators are indicated, attach an electric motor-actuated valve control unit to the actuating mechanism housing by means of a flanged motor adapter piece.

2. Gearing

a. Provide the motor actuator with the motor, reduction gearing, reversing starter, torque switches, and limit switches in a weather-proof National Electrical Manufacturers Association (NEMA) 4X assembly.

b. Provide a single- or double-reduction unit, consisting of spur or helical gears and worm gearing.

c. Construct the spur or helical gears of hardened alloy steel, and the worm gear of alloy bronze.

d. Accurately cut gearing with hobbing machines.

e. Power gearing shall be grease- or oil-lubricated in a sealed housing.

f. Use ball or roller bearings throughout.

g. Actuator output speed changes shall be mechanically possible by simply removing the motor and changing the exposed or helical gearset ratio without further disassembly of the actuator.

3. Starting Device

a. Except for modulating valves, design the unit such that a hammer blow is imparted to the stem nut when opening a closed valve or closing an open valve.

b. The device shall allow free movement at the stem nut before imparting the hammer blow.

c. The actuator motor shall attain full speed before the stem load is encountered.

4. Switches

a. Electronic-Type Switches

i. Limit switches or valve position shall be sensed by a 15-bit, optical, absolute position encoder.

ii. The open and closed positions shall be stored in a permanent, non-volatile memory.

iii. The encoder shall measure valve position continuously, including both motor and hand wheel operation, with or without use of battery.

iv. Provide an electronic torque sensor.

v. Provide an adjustable torque limit, from 40 to 100 percent of rating in one-percent increments.

vi. The motor shall be de-energized if the torque limit is exceeded.

vii. Provide a boost function in order to prevent torque-trip during initial valve unseating, and a “jammed valve” protection feature with automatic retry sequence in order to de-energize the motor if no movement occurs.

viii. Provide valve actuators with electronic type switches as manufactured by **Limitorque, Rotork** or **Auma Actuators, Inc**.

b. The actuator shall be wired in accordance with the schematic diagram.

c. Connect wiring for external connections to marked terminals.

d. Provide one 1-inch and one 1-1/4-inch conduit connection in the enclosing case.

e. Mount a calibration tag near each switch, correlating the dial setting to the unit output torque.

f. Switches shall not be subject to breakage or slippages due to over-travel.

g. Do not use traveling-nuts, cams, or microswitch tripping mechanisms.

h. Provide limit switches of the heavy-duty, open contact type, with rotary wiping action.

5. Handwheel Operation

a. Provide a permanently attached handwheel for emergency manual operation.

b. The handwheel shall not rotate during electrical operation.

c. The maximum torque required on the handwheel under the most adverse conditions shall not exceed 60 pound-foot, and the maximum force required on the rim of the handwheel shall not exceed 60 pounds.

d. Cast or permanently affix an arrow and either the word "OPEN" or "CLOSE" on the handwheel in order to indicate the appropriate direction to turn the handwheel.

e. Provide a clutch lever to put the actuator into handwheel operation.

f. Provide chain activator handwheels for valves with electric motor actuators having stems more than seven feet above the floor.

g. Provide the clutch lever with a cable secured to the chain in order to allow disengagement for manual operation.

6. Motor

a. Provide a motor of the totally enclosed, non-ventilated, high-starting torque, low-starting current type, for full-voltage starting.

b. The motor shall be suitable for operation on 480-volt, 3-phase, 60-Hz current, with Class F insulation and a motor frame with dimensions in accordance with the latest revised NEMA MG Standards.

c. The observed temperature rise by thermometer shall not exceed 55°C above an ambient temperature of 40°C, when operating continuously for 15 minutes under full-rated load.

d. With a line voltage ranging between 10 percent above to 10 percent below the rated voltage, the motor shall develop full-rated torque continuously for 15 minutes without causing the thermal contact protective devices imbedded in the motor windings to trip or the starter overloads to drop out.

e. Provide bearings of the ball type, and provide thrust bearings where necessary.

f. Provide the bearings with suitable seals in order to confine the lubricant and to prevent the entrance of dirt and dust.

g. Provide watertight motor conduit connections.

h. Motor construction shall incorporate the use of stator and rotor as independent components from the valve operation such that the failure of either item shall not require actuator disassembly or gearing replacement.

i. Provide two Class B thermal contacts or solid-state thermistors embedded within the motor windings in order to protect against over-temperature damage.

j. Provide the motor with a space heater suitable for operation on a 120-volt, single-phase, 60-Hz circuit, unless the entire actuator is of a hermetically sealed, non-breathing design with a separately sealed terminal compartment which prevents moisture intrusion.

k. Provide each electric motor actuator with a local disconnect switch or circuit breaker in order to isolate power from the motor and controller during maintenance activities.

7. Controls

a. Furnished actuator controls shall be as per the control functions detailed in the piping and instrumentation diagram (P&ID) drawings and Division 40 specifications

b. Where hardwired controls are indicated, the furnished actuator control module shall support signaling as follows:

c. Discrete Position Open Status

d. Discrete Position Closed Status

e. Discrete control status (Local/Remote).

f. Discrete Open / Close Command (single output)

g. Discrete high-high torque alarm

h. 4-20 mA Position Feedback (for modulating valves)

i. 4-20 mA Position Control Signal (for modulating valves)

j. Refer to the P&ID drawings for any additional hardwired signaling requirements for specific valves and gates

k. Status lights shall be red for "OPEN" and green for "CLOSED."

8. Open/Close Operating Speed

a. Unless otherwise indicated, electric actuators shall provide a full-close-to-full- open or full-open-to-full-close operating time range from 30 to 55 seconds.

b. Open/close speed of motor/power-actuated valves/gates shall be as indicated in the control valve/gate actuator schedule.

9. Valve and gate tag numbers, locations, area classifications, service, size, operating head, communication type, and motor type shall be as indicated in the valve/gate actuator schedule.

10. Elevated Valves

a. For valves with electric motor actuators where the valve centerline is located at a height greater than 6 feet above the floor, provide a remote actuator control station at a location no higher than four feet above the floor.

b. Provide conduit and wiring between the actuator controls and the valve actuator for these applications.

c. Wall-mount the actuator controls beneath the valve at a location approved by the Engineer.

B. Electric Motor Actuators (AC Reversing Control Type)

1. General

a. Where indicated, electric motor actuators shall be the AC reversing type complete with local control station with OPEN/CLOSE and LOCAL/OFF/REMOTE selector switches.

2. Actuator Appurtenances

a. Provide the actuator for each valve with: OPEN and CLOSE status lights; OPEN, CLOSE, and LOCKOUT/STOP push buttons; and, other indicated devices.

3. Starter

a. Provide a suitably sized amperage-rated reversing starter with its coils rated for operation on 480-volt, 3-phase, 60-Hz current.

b. Provide a control power transformer in order to provide a 120-volt source, unless otherwise indicated.

c. Equip the starter with 3 overload relays of the automatic reset type, and wire the control circuit as indicated.

d. The integral weatherproof compartment shall contain a suitably sized 120-volt AC, single-phase, 60-Hz space heater in order to prevent moisture condensation on electrical components.

e. Provide a local power disconnect switch and a close-coupled, padlockable switch with each actuator.

4. Local Control Station

a. Provide each actuator with a local control station along with the valve actuator assembly as indicated on the P&IDs.

b. The station shall include OPEN, CLOSE, and STOP push buttons, and a LOCAL/OFF/REMOTE selector switch.

c. The local control station and local power disconnect may be provided as an integral part of the actuator, or as otherwise indicated or required in order to permit operation by a person at floor elevation and within sight of the valve actuator.

5. Electric Motor Actuators (AC Reversing Control Type) Manufacturer, or Equal

a. EIM

b. Auma Actuators, Inc.

c. Limitorque Corp

d. Rotork

C. Electric Motor Actuators (AC Modulating Control Type)

1. General

a. Where indicated, modulating electric motor actuators shall be of the AC-modulating type, provided complete with a local control station with power disconnect switch or circuit breaker, LOCAL/OFF/REMOTE switch, non-latching OPEN/CLOSE pushbuttons, and OPEN/CLOSE status lights

2. Actuator Appurtenances

a. Provide the actuator for each valve with: a padlockable disconnect switch; OPEN and CLOSED status lights; OPEN, CLOSE, and LOCKOUT/STOP pushbuttons; a LOCAL/REMOTE selector switch; and, other indicated devices.

3. Control Module

a. Provide a control module of the electronic solid-state AC type, with control outputs for positioning the valve via four to 20 mA input signals.

4. Starter

a. The actuator shall control a solid-state reversing starter designed for minimum susceptibility to power line surges and spikes.

b. The solid-state starter and control module shall be rated for continuous modulating applications.

c. The power supply shall be 480-volt, 3-phase, 60-Hz.

d. Provide a disconnect switch with each actuator.

5. Construction

a. The control unit shall be microprocessor-based and shall contain an analog/digital converter, separate input-output switches, non-volatile random access memory for storage of calibration parameters, and push-button calibration elements for field setup.

b. Potentiometer adjustments shall contain a PID control function internally.

c. The controller shall contain as a standard feature a loss-of-command signal protection selectable to lock in last or lock in pre-set valve position and a valve position output signal in 4 to 20 mA.

d. As an alternative to the construction requirement, provide a motor capable of modulating at a rate of 600 starts per hour at the 50 percent to 85 percent travel range of the valve.

e. The system shall allow the control of the open, close, or percent open function when the LOCAL/OFF/REMOTE switch is in the REMOTE position.

f. Provide each actuator with a frequency shut-down system, which when pre-programmed shall function as directed upon receipt of an ESD signal.

6. Electric Motor Actuators (AC Modulating Control Type) Manufacturer, or Equal

a. **EIM**

b. **Limitorque**

c. **Rotork**

d. **Auma Actuators, Inc.**

D. Electric Motor Actuators (DC Modulating Control Type)

1. Equipment Requirements

a. Where indicated, provide electric motor actuators of the DC modulating control type, and attach to the actuating mechanism housing.

2. Actuator Assembly

a. The assembly shall include a DC motor, reduction gearing, a control unit, limit-switches, and required accessories, within one enclosure.

3. Control Unit

a. Provide an electric motor-operated control unit suited for an input power supply of 90 to 140 volts, 60 Hz AC, and to operate satisfactorily when input power is within those limits.

b. Power will be supplied at 120 volts, single-phase, 60 Hz AC.

c. Provide a control unit suited to receive an input set-point signal from an external source of 4 to 20 ma DC with properly selected calibrating resistor.

4. Control Panel

a. Provide each actuator with a separate local control panel for attachment to the valve actuator assembly.

b. Provide the panel with an OPEN/CLOSE/AUTO/HOLD selector switch and suitable for indoor or outdoor installation, as required.

5. Electric Motor Actuators (DC Modulating Control Type) Manufacturer, or Equal

a. **EIM, Futronic-III**

b. **Limitorque Corp., Modutronic-10**

E. 120 V Quarter-Turn and Multi-Turn Electric Valve Operators (6-Inches and Smaller)

1. Provide 120-volt, single-phase, motor-operated valve operators suitable for use with quarter-turn ball valves, multi-turn diaphragm valves, and multi-turn globe valves.

2. Provide operators with the following characteristics and features:

a. reversing capacitor-start motor rated for operation on 120 VAC, 60 Hz, single-phase;

b. output torque as required for valve application and pressure differential;

c. integral motor overload protection, with auto-reset;

d. permanently-lubricated gear train;

e. OPEN/CLOSE Control

i. For OPEN/CLOSE control, provide 4 single-pole, double-throw cam-actuated limit switches (2 OPEN, 2 CLOSED);

ii. Use one set of limit switches for both motor control and local indication;

iii. Make the other set available for connection to remote monitoring;

iv. Provide adjustable limit switch contacts rated for not less than 5 amps at 120 VAC;

f. Local Control Station: OPEN/CLOSE

i. corrosion-resistant, NEMA 4X, for mounting near valve actuator;

ii. Provide 2-position selector switch for LOCAL/REMOTE selection and 2 pushbuttons, OPEN and CLOSE;

iii. Provide OPEN and CLOSE indicating lights operating at 120 VAC for connection to valve control limit switches;

g. Modulating Control

i. For modulating control, provide an electronic positioner and feedback potentiometer;

ii. The positioner shall use a 4 to 20 ma signal to adjust the valve opening;

iii. Feedback potentiometer shall be 0 to 1000 ohms;

h. Local Control Station Modulating

i. corrosion resistant, NEMA 4X, for mounting near valve actuator;

ii. Provide 2-position selector switch for LOCAL/REMOTE selection, one OPEN and one CLOSE push button, a resistance-to-current converter with 4 to 20 mA output, and a zero to 100 percent electronic valve position indicator; and,

i. Disconnect Switch

i. Provide a local power disconnect switch, NEMA 4X, for disconnecting the 120 VAC power to the valve; and,

ii. Install the disconnect in the field within sight of the valve actuator, in accordance with the requirements of National Fire Protection Agency (NFPA) 70.

3. Refer to the Drawings for the control diagram wiring interface.

4. Two-wire control systems are not required for this actuator.

5. 120 V Quarter-Turn and Multi-Turn Electric Valve Operators (6-Inches and Smaller) Manufacturer, or Equal

a. **RCS**

b. **Asahi/America, Quarter Master**

2.04 PNEUMATIC ACTUATORS

A. General

1. Controls

a. Provide pneumatic cylinder actuators with every necessary pneumatic or electro-pneumatic control for the intended actuation of the valve or gate.

b. Manufacturer, or Equal

i. **G.H. Bettis/Shafer**

ii. **Fisher Controls**

iii. **Miller Fluid Power**

iv. **Neles-Jamesbury, Inc.**

v. **Rexroth Corporation**

2. Filters, Regulators, and Lubricators

a. Where required by the service and type of actuator, provide filters, regulators, and oil-lubricators in the air supply to the actuator, according to the manufacturer's instructions.

3. Air Supply

a. Size pneumatic actuators for the available air pressure as indicated, and provided with isolating valves, adjustable filter-regulators, pressure gauges, and condensate drains.

b. The filter elements shall be replaceable 40-micron units.

c. Manufacturer, or Equal

vi. **Fisher Controls**

vii. **Miller Fluid Power**

B. Diaphragm Actuators

1. Construction

a. Provide an actuator consisting of: a ductile-iron, aluminum, or carbon steel diaphragm housing, and stainless steel or carbon steel stem; a ductile-iron or cast-iron yoke and spring barrel with carbon steel spring; and, Nitrile-covered fabric diaphragm of sufficient strength for the maximum expected torque or force.

2. Manual Override

a. Provide each actuator with a manual handwheel override, top-mounted for linear actuation, and worm gear mounted with declutchable handwheel for rotary actuation.

b. The worm gear construction shall be as indicated for manual actuators.

3. Manufacturer, or Equal

a. **Fisher Corporation**

b. **ITT Engineered Valves**

c. **Neles-Jamesbury, Inc**

PART 3 -- EXECUTION

3.01 SERVICES OF MANUFACTURER

A. Field Adjustments

1. The adjustment of actuator controls and limit switches in the field for the required function shall be performed by field representatives of the manufacturers of valves or gates with pneumatic, hydraulic, or electric actuators.

3.02 INSTALLATION

A. Install valve and gate actuators and accessories in accordance with the requirements of Section 43 30 00 – Hydraulic Process Valves.

B. Locate the actuators to be readily accessible for operation and maintenance without obstructing walkways.

C. Do not mount actuators where shock or vibrations will impair their operation, and do not attach the support systems to handrails, process piping, or mechanical equipment.

END OF SECTION

SECTION 40 10 00
PROCESS CONTROL & INSTRUMENTATION SYSTEM-GENERAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. General requirements applicable to all process control work.
2. The requirements of this Section apply to all components of the Software Systems unless indicated otherwise.
3. General requirements for programming submittals.

B. Related sections:

1. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Subcontractors to review all sections to ensure a complete and coordinated project:

    a. Items involving electrical, control, and instrumentation construction may be shown on Drawings or referred to in Specifications that do not apply specifically to electrical, control and instrumentation systems.

C. The Programming Contractor shall design, furnish, and program all PLC's and the SCADA system. The Programming Contractor shall provide all software as specified herein for programming the system. The Programming Contractor and the electrical contractor shall be responsible to test each device and loop to verify proper function of all equipment on the project, whether provided by the contractor or by the owner. They shall then work with the owner to test and commission the entire system as described herein. The programming contractor shall be present to test the I/O for each equipment subsystem. The I/O to the PLC systems shall be tested at this time. The programming contractor shall provide and install a simple testing routine in each PLC in order to verify all I/O is functioning properly. All I/O shall be tested from its respective field device to the software level in the PLC. If final PLC programming is complete at the time of testing, the final software programming shall be used to test each device

D. The Programming Contractor shall design the operator interface graphics, human machine interface (HMI) graphics, PLC logic, and control systems hardware as specified herein.

E. The Programming Contractor for this project shall be APCO, hired by the General Contractor.

F. Contract Documents:

1. General:

a. Contract documents consist of drawings, specifications, and other documents issued by the ENGINEER. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work, and requirements shown, written or reasonably inferred there from on one is considered as written, shown or implied in all. In the event work is called for in more than one place and there are conflicting requirements, the right shall be reserved to require the installation of the larger or the more expensive.
b. Schematic Diagrams:
    1) All controls are shown de-energized.
        a) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.
        b) Control schematics are to be used as a guide in conjunction with the descriptive operating sequences found in the Drawings or Specifications. Combine all information and furnish a coordinated and fully functional control system program.

1.2 REFERENCES

A. Code Compliance:
    1. The publications are referred to in the text by basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of Bid governs
    2. The following codes and standards are hereby incorporated into these Specifications:
        a. National Fire Protection Association (NFPA):
            1) NFPA 70 - National Electric Code (NEC).
            2) NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
            3) NFPA 496 - Purged and Pressurized Enclosures for Electrical Equipment, where applicable.
            4) NFPA 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
        b. Underwriters Laboratories, Inc. (UL):
            1) UL 508 - Industrial Control Equipment.
        c. American National Standards Institute (ANSI):
            1) ANSI B16.5 - Pipe Flanges and Flanged Fittings.
        d. American Petroleum Institute (API):
            1) API RP551 - Process Measurement Instrumentation.
            2) API RP552 - Transmission Systems.
            3) API RP553 - Refinery Control Valves.

4) API RP554 - Process Instrumentation and Control.
5) API RP555 - Process Analyzers.
6) API RP556 - Fired Heaters & Steam Generators.
7) API RP557 - Guide to Advanced Control Systems.

e. American Society of Testing and Materials (ASTM):

1) ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

f. Instrumentation, Systems, and Automation Society (ISA):

1) ISA-5.1 - Instrumentation Symbols and Identification.
2) ISA-5.2 - Binary Logic Diagrams for Process Operations.
3) ISA-5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.
4) ISA-5.4 - Instrument Loop Diagrams.
5) ISA-5.5 - Graphic Symbols for Process Displays.
6) ANSI/ISA-7.00.01 - Quality Standard for Instrument Air.
7) ISA-RP - 12.4 - Pressurized Enclosures.
8) ANSI/ISA-18.1 - Annunciator Sequences and Specifications.
9) ISA-20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.
10) ISA-TR20.00.01 - Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations Updated with 27 New Specification Forms in 2004-2005.
11) ANSI/ISA-50.00.01 - Compatibility of Analog Signals for Electric Industrial Process Instruments.
12) ISA-51.1 - Process Instrumentation Terminology.
13) ISA-RP60.3 - Human Engineering for Control Centers.
14) ISA-71.01 - Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity.
15) ISA-71.02 - Environmental Conditions for Process Measurement and Control Systems: Power.
16) ISA-71.03 - Environmental Conditions for Process Measurement and Control Systems: Mechanical Influences.
17) ISA-71.04 - Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants.

1.3 DEFINITIONS

A. Definitions of terms and other electrical and instrumentation considerations as set forth in the:

1. National Electrical Code.
2. Institute of Electrical and Electronic Engineers.
3. Instrumentation, Systems, and Automation Society.
4. National Fire Protection Association.
5. National Electrical Testing Association.

B. Specific Definitions:

1. Control Circuit: Any circuit operating at 120 volts AC or DC or less, whose principal purpose is the conveyance of information (including performing logic) and not the conveyance of energy for the operation of an electrically powered device.
2. Panel: An instrument support system that may be either a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term “panel” in these Contract Documents is interpreted as a general term, which includes flat surfaces, enclosures, cabinets and consoles.
3. Power Circuit: Any circuit operating at 90 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.
4. Signal Circuit: Any circuit operating at less than 50 volts AC or DC, which conveys analog information or digital communications information.
5. Digital Bus: A communication network, such as Profibus, Foundation Fieldbus, or DeviceNet, allowing instruments and devices to transmit data, control functions and diagnostic information.
6. 2-Wire Transmitter (Loop Powered): A transmitter that derives its operating power supply from the signal transmission circuit and requires no separate power supply connections. As used in this Specification, two-wire transmitter refers to a transmitter that provides 4 to 20 mA current regulation of a signal in a series circuit with an external 24 VDC driving potential.
7. Field Bus Communications signal or both.
8. Powered Transmitters: A transmitter that requires a separate power source (120 VAC, 240 VAC, etc.) in order for the transmitter to develop its signal. As used in this Specification, the produced signal may either be a 4 to 20 mA current signal, a Digital Bus communications signal or both.
9. Modifications: Changing, extending, interfacing to, removing or altering an existing circuit.

C. Acronym Definitions:

1. ES: Enterprise System: Computer based communications or data sharing system utilized for non-process control functions such as E-mail, sharing files, creating documents, etc.
2. FAT: Factory Acceptance Test.

3. HOA: Hand-Off-Auto control function that is totally PLC based. In the Hand mode of control equipment is started or stopped, valves are opened or closed through operator direction under the control of the PLC software. In the Auto mode of control equipment is started or stopped, valves are opened or closed through a control algorithm within the PLC software. In the Off mode the equipment is prohibited from responding from the PLC control.
4. HMI: Human Machine Interface: PLC based operator interface device consisting of an alphanumeric display and operator input devices. The HMI is typically a flat panel type of display with either a touch screen or tactile button interface.
5. HVAC Heating, Ventilation, & Air Conditioning.
6. ICSC: Instrumentation and Control System Contractor: Subcontractor who specializes in the design, construction, fabrication, software development, installation, testing, and commissioning of industrial instrumentation and control systems.
7. IJB: Instrument Junction boxes. A panel designed with cord sets to easily remove, replace or relocate instrument signals.
8. I/O: Input / Output.
9. LCP: Local Control Panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
10. LAN: Local Area Network: A control or communications network that is limited to the physical boundaries of the facility.
11. LOR: Local-Off-Remote control function. In the Remote mode equipment is started or stopped, valves are opened or closed through the PLC based upon the selection of the HOA. In Local control, equipment is started or stopped, valves are opened or closed based upon hardwired control circuits completely independent of the PLC with minimum interlocks and permissive conditions. In the Off mode, the equipment is prohibited from responding to any control commands.
12. OIT: Operator Interface Terminal. PC based interface device used for operator interface with the SCADA system.
13. P&ID: Process and Instrumentation Diagram.
14. PC: Personal Computer.
15. PCIS: Process Control and Instrumentation System, includes the entire instrumentation system, the entire control system, and all of the work specified in Division 17 and depicted on the Instrumentation Drawings.
16. PCM: Process Control Module: An enclosure containing any of the following devices: PLC, RIO.
17. PJB: Power Junction Box: An enclosure with terminal blocks that distribute power to multiple instruments.
18. PLC: Programmable Logic Controller.
19. RIO: Remote I/O device for the PLC consisting of remote I/O racks, or remote I/O blocks.

20. RTU: Remote Telemetry Unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
21. SCADA: Supervisory Control and Data Acquisition system consists of the computer-based software system that includes the operator interface, data storage, data retrieval, archiving, alarming, historian, reports, trending, and other higher level control system software.
22. UPS Uninterruptible Power Supply.
23. VCP: Vendor Control Panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, OIT, HMI, etc.
24. WAN: Wide Area Network: A control or communications network that extends beyond the physical boundaries of the facility.

1.4 SYSTEM DESCRIPTION

A. General Requirements:

1. The Work includes everything necessary for and incidental to executing and completing the general requirements for programming the control system described in the Contract Drawings and Specifications and reasonably inferable there from including but not limited to:

   a. Procure all software.
   b. With the electrical contractor, perform post programming tests on panels.
   c. With the electrical contractor, oversee, document, and certify system pre-commissioning.
   d. With the electrical contractor, conduct the Performance Tests.
   e. Prepare Operation and Maintenance Manuals.
   f. Conduct training classes.
   g. Develop all requisite loop descriptions, functional narrative and instructions and record drawings associated with the programs provided under other Divisions of these Specifications.

2. It is the intent of these Specifications that the programmed system be complete and operable.
3. Furnish detailed, complete, and thorough operations and maintenance documentation, including, but not limited to: Operations Manuals, Maintenance Manuals, Training Manuals, As-Built Software Documentation, final as installed software configurations, and software disks including installed program disk.

1.5 SUBMITTALS

A. General:

1. Furnish Submittals that are fully developed for a given section of the work and fully indexed with a tabbed divider for every element and component.

2. Sequentially number the pages within the tabbed sections. Submittals and Operation and Maintenance manuals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.
3. Edit all Submittals and Operation and Maintenance Manuals so that the submittal specifically applies to only the equipment furnished. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.
4. Submittal Requirements:
    a. Submit copies of shop drawings, and product data, in accordance with the requirements of this Section:
        1) Show information on software to be supplied, SCADA screens, reports, menus, operation, etc.
5. Exceptions to Specifications and Drawings:
    a. Include a list of proposed exceptions to the Specifications and Drawings along with a detailed explanation of each.
    b. Any exceptions to the Specification and Drawings must be noted and the reason for the exception explained.
    c. If there is insufficient explanation for the deviation, the submittal will be returned requiring Revision and Re-submittal.
    d. Acceptance of any exception is at the sole discretion of the ENGINEER. Furnish all items (materials, features, functions, performance, etc.) that are not listed as exceptions strictly in accordance with the Specifications and Drawings.
    e. Replace all items that do not strictly meet the requirements of the Specifications, which were not previously accepted as exceptions, even if the Submittals contained information indicating the failure to meet the requirements.
6. Submittal Organization:
    a. First page:
        1) Specification Section reference.
        2) Name and telephone number of individual who reviewed submittal before delivery to ENGINEER.
        3) Name and telephone number of individual who is primarily responsible for the development of the submittal.
        4) Place for CONTRACTOR's review stamp and comments.
    b. Next pages:

1) Provide confirmation of Specification compliance in a tabular form that individually lists each Specification section, paragraph, and sub-paragraphs and unequivocally states compliance with said requirement or takes exception to the requirement and lists the reason for said exception and offers alternative means for compliance.
2) Include a response in writing to each of the ENGINEER's comments or questions for submittal packages which are re-submitted:

c. In the order that the comments or questions were presented throughout the submittal.
d. Referenced by index section and page number on which the comment appeared.
e. Acceptable responses to ENGINEER's comments are either:
f. ENGINEER's comment or change is accepted and appropriate changes are made.
g. Explain why comment is not accepted or requested change is not made.
h. Explain how requirement will be satisfied in lieu of comment or change requested by ENGINEER.
i. Any re-submittal, which does not contain responses to the ENGINEER's previous comments, shall be returned for revision and re-submittal.
j. No further review by the ENGINEER will be performed until a response for previous comments has been received.
k. Remaining pages:

1) Actual Submittal data:

a) Organize Submittals in exactly the same order as the items are referenced, listed, and/or organized in the Specification section.
b) For Submittals that cover multiple devices used in different areas under the same Specification section, the Submittal for the individual devices must list the area where the device is intended to be used.

l. Specific Submittal requirements:

1) Furnish the submittals required by each Section or Division 17:

a) Product Data.
b) Shop Drawings.

m. Furnish submittals in the following general order, each in a separate bound set:

1) Product Data.
2) After approval of the Product Data, submit the Project Shop Drawing submittals
3) Testing, Calibration and Start-up procedures.
4) Operation and Maintenance Data.

5) Training Submittals.
6) Record Documents.

B. Product Data:

1. General:

a. Submitted for non-custom manufactured material listed in this and other sections and shown on shop drawings.
b. Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.
c. Include:

1) Catalog cuts.
2) Bulletins.
3) Brochures.
4) Quality photocopies of applicable pages from these documents.
5) Identify on the data sheets the project name, applicable specification section, and paragraph.
6) Identify model number and options for the actual equipment being furnished.

d. Neatly cross out options that do not apply or equipment not intended to be supplied.

2. Software Data Sheets and Cut Sheets:

a. Provide fully completed data sheets , in hardcopy, for each software package. Including the following information on the data sheet:

1) License limitations, points, screens available.
2) Description of software compatibilities with hardware (PLC's, ethernet communications, P.C.'s, modems, HMI's, etc.)
3) Description of software capabilities, function and use.

3. Software Program Submittal:

a. Prepare a program submittal to demonstrate how the programs address the following:

1) Alarm indication and notification.
2) Alarm acknowledgement.
3) Operational sequences.
4) Communications.
5) Recording and trending – show for each recorded or tended tag.
6) Report generation with samples.
7) Maintenance information and notes storage.

8) Samples of each screen shot and report.

C. Operation and Maintenance Manuals:

1. Furnish the ENGINEER with a complete preliminary set of written Operation and Maintenance Manuals 2 weeks before start-up and/or testing.
2. Furnish in accordance with the following additional requirements.
3. Submit preliminary sets of these manuals to the ENGINEER for review of format and content:

   a. ENGINEER will return 1 set with comments.
   b. Revise and/or amended as required and submit the requisite number of copies to the ENGINEER 15 days before Pre-commissioning of the systems.

4. Incorporate changes that occur during startup and submit as part of the final manuals.
5. Provide comprehensive information on all systems and components to enable operation, service, maintenance, and repair.
6. Organize the Operation and Maintenance Manuals for each process in the following manner:

   a. Section A-Description of operation.
   b. Section B- Screen shots.
   c. Section C- Report samples.
   d. Section D- Trending/recording operations.
   e. Section E- Software information with disks.
   f. Section F- Operational Manual.
   g. Section G- Spare Parts List.

7. Training Submittals:

   a. Develop and submit for review a General Training Plan. Include complete descriptions of all planned training classes, a preliminary training schedule, a list of all proposed instructors along with resumes, examples of proposed training manuals, and a description of any special training tools to be used (simulators, self-paced modules, personal computer-based training, etc.).
   b. The ENGINEER will review the General Training Plan. Special emphasis will be placed on review of the qualifications of the proposed instructors and the timing of the individual courses to maximize their effectiveness. If, in the opinion of the ENGINEER, the proposed instructors are not sufficiently qualified to conduct the specified training courses, or lack experience, where required, on the specific configuration of the system provide more qualified instructors.
   c. Training Course Plan submittals:

      1) For each training course or other training activity, submit a detailed, complete outline and agenda for each lesson.

2) Describe any student pre-requisites for the course or training activity.
3) Provide an updated schedule for all sessions of the course, including dates, times, durations, and locations.
4) Submit training materials.

d. Incorporate all submittal review comments into the course.
e. Do not conduct training courses before review and acceptance of the Course Plan submittal for the course.

D. Responsibilities

1. The Programming Contractor, shall be responsible to the OWNER for the implementation of the software and programmed systems.
2. Instrumentation & Control System Contractor (ICSC) Responsibilities:

a. The Programming Contractor shall assume full responsibility to perform all engineering to select, furnish, install, test, calibrate, and place into operation all software for PLC's and SCADA P.C.'s.
b. The Programming Contractor shall be responsible for coordination with OWNER to provide a complete, integrated and functional software system.
c. As a minimum, the Programming Contractor shall perform the following work:

1) Prepare software submittals.
2) Design, develop, and implement controls, screens, reporting, recording, etc.
3) Prepare the test plan, the training plan, and the spare parts submittals.
4) Procure all software.
5) Perform tests on PLC and SCADA software.
6) Participate in system pre-commissioning.
7) Participate in the performance tests.
8) Prepare Technical Manuals.
9) Conduct training classes.

3. Owner's Responsibilities:

a. Assist the Programming Contractor in coordinating and integrating the system controls.
b. The Programming Contractor shall not be responsible for providing or testing any hardware.

4. The Programming Contractor and the Instrumentation & Control System Contractor will be one and the same for this contract.

E. Programmer Qualifications:

1. The Qualification requirements specified in these paragraphs apply to the portions of the Process Control and Instrumentation System Work to be provided by the Programming Contractor.

2. The Programming Contractor shall meet the following minimum qualifications:
    a. The Programming Contractor shall have completed at least five (5) successfully completed projects for a pumping system of similar scope and complexity in which the Programming Contractor used components the same as those intended for use on this project, performed system programming, documentation, including software configuration and documentation, field testing, calibration and start-up, operator instruction and maintenance training.
    b. The Programming Contractor company shall be actively involved in the instrumentation, PLC based control systems, and SCADA systems business for a minimum of ten years and has adequate facilities, organization structure, manpower and technical and managerial expertise to properly perform the WORK under and in conformance with these Specifications.

1.6 SEQUENCING

A. General:
    1. Testing requirements are specified in Division 27.
    2. Work restrictions and other scheduling requirements are specified in the General specifications.

B. Pre-submittal Conferences:
    1. Before producing any submittals, schedule a pre-submittal Conference for the purposes of reviewing the entire project, equipment, control philosophy, schedules, and submittal requirements.

C. Training:
    1. Complete all training before the pre-commissioning phase of the project may start.
    2. Schedule the training sessions a minimum of 15 days prior to the start date of the courses.
    3. Submit training manuals to the ENGINEER a minimum of 10 days before starting the training session.
    4. Within 10 days after the completion of each session, submit the following:
        a. A list of all OWNER personnel that attended the session.
        b. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.

D. Performance Testing:
    1. Complete Pre-commissioning test a minimum of 5 days before the Performance Test.
    2. Conduct a 90-day Performance Test.

1.7 WARRANTY

A. Warrant the Software and Programming in accordance with the General Conditions:

1. Provide additional warranty as specified in the individual Division 17 Specifications.

1.8 SYSTEM STARTUP

A. Replace or modify software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:

1. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the ENGINEER.

1.9 MAINTENANCE

A. Before Substantial Completion, perform all maintenance activities required by any sections of the Specifications including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.

PART 2 - PRODUCTS
PART 3 - EXECUTION

3.1 DEMONSTRATION AND TRAINING

A. Training:

1. General:

a. Provide system maintenance and operator training courses for all the instrumentation and control systems furnished.

b. Conduct all training at the Project Site unless another location is approved by the ENGINEER and OWNER.

1) Include instruction on the use of all maintenance equipment and special tools provided under the contract.

c. Tailor training classes to the specific needs of the class participants:

1) The specific categories and number of personnel in each category are identified below.

2) Furnish training courses that are a combination of classroom and hands-on training:

3) Present the minimum number of sessions, specified in Table 1, for each course in order to satisfy class size restrictions and limitations scheduling OWNER staff.

4) Furnish additional sessions if required to accommodate the total number of personnel identified for each course.

5) Schedule individual training classes with the OWNER at least 3 weeks before the start of the class.
6) Schedule all training classes Monday - Friday between 7:30 AM and 3:30 PM.
7) Each individual daily training session, travel time excluded:
    a) Minimum duration of 4 hours.
    b) Maximum duration of 7 hours.
    c) Breaks scheduled at least every 90 minutes and 1 hour for lunch.
8) Complete training for maintenance personnel 90-days before Performance Testing.
9) Complete operator training classes before startup of the SCADA system, or any part of it:
10) Refer to Paragraph 1.09 of this Section.
11) Schedule follow-up training classes after SCADA startup on a schedule determined by the OWNER.
    a) Furnish highly qualified training instructors for technical training with demonstrated expertise in not only control system functionality but also professional training techniques:
    b) Provide completion reports in accordance with Paragraph 1.09 of this Section.

2. Training Manuals and Materials:
    a. Furnish training manuals and other materials for training courses.
    b. Manuals are to be professionally written to present the course material in a format that is easy to comprehend.
    c. The manuals are to serve as teaching aids during presentation of the training classes.
    d. Manuals are to serve as reference material after the training has been completed.

Table 1

Course Title	Minimum Course Length (days per session)	Personnel (Estimated Number of Students)	Minimum Number of Sessions
SCADA, HMI, PLC Software	1	5	1

3. Training Course Requirements:
    a. Software Training:

1) Furnish training on software and on related systems, including operation alarms, control, recording, reporting, etc.
2) Furnish training on features, operation, troubleshooting, and maintenance.

b. HMI Training:

1) Provide the following:

a) Overview of firmware, including starting, stopping, and PLC interface.
b) Troubleshooting.

c. Follow-up Training:

1) Provide on-site follow-up training class beginning after startup of the SCADA system. The intent for these classes is to provide the OWNER's personnel the opportunity for a review and "refresher" of the training topics and material after they have had some experience using the system.
2) Mutually schedule and develop the content of these classes with the OWNER no later than 1 month before the beginning of the first session:

a) Schedule at the OWNER's discretion on non-consecutive days spaced out over the start-up and warranty period.

END OF SECTION

SECTION 40 11 00
PROGRAMMABLE LOGIC CONTROLLER (PLC)

PART 1 GENERAL

1.1 SCOPE

A. Furnish all labor, material, equipment, appliances, and perform all operations in connection with providing a complete and operable programmable logic controller (PLC) system in accordance with this section of the specifications and applicable drawings and subject to the terms and conditions of the Contract.
B. The SUPPLIER shall furnish a PLC control system utilizing Allen Bradley MicroLogix family of hardware as specified herein. No like, equal, or equivalent products will be considered.
C. The SUPPLIER shall furnish PLC programming software.
D. The CONTRACTOR'S programmer shall work in conjunction with the contractor to train the owner on the PLC system. The contractor shall train the owner on all hardware. The programmer shall train on PLC programming, SCADA programming, operations, fault clearing, start-up and shutdown procedures, etc.
E. The SUPPLIER and the CONTRACTOR will be one and the same for this contract. There will not be a separate contract for PLC programming.

1.2 APPLICABLE SECTIONS

A. The General Conditions, Supplementary General Conditions, Special Conditions, alternates and Addenda, applicable drawings and the technical specification herein shall apply to work under this Section.

1.3 APPLICABLE REFERENCES

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
- ANSI X3.64 (1979) Additional Controls for Use with American National Standard Code for Information Interchange

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)
- EIA232-D (Jan. 1987) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
- EIA RS-485 (1983) Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Multipoint System

FEDERAL COMMUNICATION COMMISSION (FCC)
- FCC Part 68 (July 1986) Connection of Terminal Equipment to the Telephone Network

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)
- IEEE No. 100 (1988) IEEE Standard Dictionary of Electrical and Electronic Terms

IEEE C57.13 (1978) Instrument Transformers
IEEE C62.41 (1980) Surge Voltages in Low-Voltage AC Power Circuits
IEEE 802.3 Carrier Sense Multiple Access/Collision Detection (CSMA/CD)
NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA 250 (1985; Incl. Rev. I and 2; ICS-6) Enclosures for Electrical Equipment
NEMA ICS 1 (1988) General Standards for Industrial Controls and Systems
UNDERWRITERS LABORATORIES, Inc. (UL)
UL 50 Enclosures for Electrical Equipment
UL 508 Industrial Control Equipment

1.4 SUBMITTALS

A. Provide complete submittal information for the PLC system as specified in Sections 01 34 00 and 26 05 00. Include manufacturer's data for each part, Bill of Materials, panel fabrication drawings including elevations and complete wiring diagrams with wire and terminal numbers for local and remote terminations. Remote terminations may be submitted with the operational and maintenance information in lieu of the initial equipment submittals.
B. Provide operational and maintenance information as specified in Section 26 05 00.

1.5 RELATED SECTIONS

A. Section 26 05 30 - Static Un-Interruptible Power Supply
B. Section 26 09 13 – Control Devices
C. Appendix A

PART 2 PRODUCTS – NOT USED

2.1 PROGRAMMABLE LOGIC CONTROLLER SYSTEM

A. The PLC system shall be Allen-Bradley MicroLogix Series. Provide hardware types as identified in Table 1-1.

TABLE 1-1 PLC HARDWARE

Part Number

1766-L Series MICROLOGIX CONTROL PROCESSOR
ETHERNET PORT
ONBOARD DIGITAL INPUTS
ONBOARD DIGITAL RELAY OUTPUTS
(2) 1762-IF4 ANALOG INPUT-CURRENT 4-20MA
(1) 1762-OF4 ANALOG OUTPUT-CURRENT 4-20MA

2.2 PLC ENCLOSURE AND ACCESSORIES

A. PLC Enclosure and Accessories: The PLC enclosure shall house the power supplies, PLC processor, analog input and output modules, discrete input and output modules, communication module, operator interface terminal (OIT), UPS, thermostatically controlled vent fan and louvers, heater with thermostat, light with integral door switch, relays, terminal blocks, and ancillary components. In addition, provide 25% spare back panel space and space for additional cards as indicated. The PLC shall be equipped with the following accessories, at a minimum:

1. Enclosure: The PLC shall be housed in a NEMA type12 enclosure with a lockable 3-point latch, and an interior swing out panel. The enclosure, swing out panel, vent fan, heater, and light shall be manufactured by Hoffman, or equal.
2. Redundant Power Supplies: Power supply hardware shall include a PLC power supply and redundant 24VDC power supplies as required for Inputs and Outputs (I/O). The redundant power supplies shall be 100 watt, minimum.
3. Fusing: Individual I/O loops shall be individually fused. Fuse holders shall be indicating type.
4. I/O Terminal Blocks: Field wiring DIN rail type terminal blocks. 25% spare terminal blocks shall be provided. Discrete and analog I/O terminals shall be segregated by I/O type.
5. Plastic Snap-On Cover Wire Management Systems: These shall be sized to accommodate all wiring with 25% spare capacity.
6. UPS System: A panel mounted UPS shall be included in each PLC cabinet. The UPS's shall be sized to provide at least 30 minutes of run time for the PLC and all system I/O. UPS systems shall be as specified elsewhere.
7. Transient Voltage Surge Suppression (TVSS): The TVSS system shall protect all power wiring within the PLC enclosure. The TVSS shall be a branch panel model as specified in Section 26 35 53.
8. Work Light and Outlet: A work light utilizing a 32 watt self ballasted compact fluorescent lamp or equal with an integral door operated switch shall be mounted within the enclosure. Enclosures over 4' wide shall include a light in each 4' section. A 20 amp, 120 volt duplex grounded power outlet shall be mounted within the PLC enclosure.
9. Ground Terminals: A screw type bonding terminal strip to which all ground bonding shall take place for all signal reference, TVSS, safety bonding etc. This grounding terminal shall accept a #6 copper ground bonding conductor. 25% spare terminals shall be provided.
10. Enclosure Labeling: The enclosure shall carry a phonetic label indicating the enclosure name, label all pilot devices on the swing out panel, and label all I/O termination modules, relays, power supplies, etc. Internal wiring shall be labeled at each terminal and each terminal shall be labeled, all labeling names and/or numbers shall be reflected on the panel fabrication drawings.
11. Separate Power Warning Signs: The enclosure shall receive power from external sources and shall be labeled with the source of where the external power is derived. Each circuit providing power to the cabinet shall be indicated.

B. Operator Interface Terminal (OIT/HMI): An OIT/HMI shall be mounted in the PLC enclosure swing-out panel. The OIT shall be 7" touchscreen or nearest available size compatible with Allen Bradley equipment, with keypad, 24VDC power, color graphics, and Ethernet communications operating from the terminal server with terminal services client software.

1. Provide OIT programming software to the OWNER, registered in OWNER's name.
2. Provide a programming cable for connection to a Personal Computer for the transfer of files.

2.3 INPUT/OUTPUT MODULES

A. Analog transmitters and receivers have 4 to 20 mA signals. Discrete (on/off) inputs (DI) originate from dry contacts. For discrete outputs (DO), provide interposing relays with dry contacts. Refer to the PLC Input / Output Point List, Appendix A, for required inputs and outputs.
B. The discrete input modules shall be 24 VDC.
C. The discrete output modules shall be isolated relay contacts suitable for operating interposing relays. Each discrete output module shall include fuses and fuse blown indicators.
D. The analog input (AI) modules shall be suitable for accepting 4 to 20 mA from 2, 3, or 4 wire transmitters. The input power shall be from an internal or external 24-volt dc power supply. The analog to digital converter shall have a 10-bit minimum resolution with an overall accuracy of + .5% at 60ºC.
E. The analog output (AO) modules shall be 4 to 20 mA signals suitable for driving into a 0 to 600 ohm load without load adjustments. The digital to analog converter shall have a 10 bit minimum resolution with an overall accuracy of + 2% to 60ºC. The output power shall be from an internal or external, 24 volt dc power supply provided by the SUPPLIER. If the PLC processor fails, the analog outputs shall retain their present value.
F. Discrete PLC I/O modules shall have individual LED status lights for each I/O point. All discrete and analog modules shall have terminal blocks for termination of the I/O wires. Individual I/O points shall be capable of withstanding low energy common mode transients to 1,500 volts.

2.4 PLC START-UP

A. Each PLC shall have start-up software that causes automatic commencement of operation without human intervention, including start-up of all connected I/O functions. A restart program based on detection of power failure shall be included in the software. Upon restoration of power, the program shall restart all equipment and restore all loads to the state at time of power failure, or to the state as commanded by time programs or other overriding programs. The restart program shall include start time delays between successive commands to prevent demand surges or overload trips. The start-up software shall initiate operation of self-test diagnostic routines. If the data base and application software are no longer resident or if the clock cannot be read, the PLC shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made. If the data base and application programs are resident, the PLC shall resume operation after an adjustable time delay of from 0 to 600

seconds. The start-up sequence for each device shall include a unique time delay setting when system operation is initiated.

B. Programming software for the PLC shall be provided by the contractor. The programming of the PLC shall be performed by the contractor. All loop testing and debugging shall be performed by the Contractor.

PART 3 EXECUTION

3.1 PANEL FABRICATION

A. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents.

B. The panel shall be fabricated and UL Listed as an assembly by a qualified panel shop.

3.2 FACTORY TESTING

A. A factory conducted test shall be preformed at the manufacturer's facility upon the completed fabrication of the PLC system. The factory test shall demonstrate the successful operation of inputs and outputs from the field terminal blocks to the PLC. Provide signal generators and measuring devices as needed for a complete and through test.

B. Hardware and software components of the PLC System shall be thoroughly tested and "burned in" by the SUPPLIER. Inform the OWNER 10 working days prior to the testing of the equipment. The OWNER shall witness these tests before shipment to the site.

C. Panel fabrication drawings shall be updated based on the factory test and a current set of drawings shall be shipped with the panel.

D. The SUPPLIER shall be responsible for all transportation, meals, accommodation, and expenses for the OWNER's representative witnessing the factory test.

3.3 OWNER TRAINING

A. Provide the services of a factory trained, manufacturer's representative for instruction of the OWNER's personnel. The training shall include basic PLC and OIT operation overview, I/O module normal and fault condition indications, and equipment maintenance, troubleshooting, and replacement.

B. The operation and maintenance manuals shall be included as a part of the instruction to the OWNER's personnel. Refer to Section 01 34 00 for operation and maintenance data requirements.

C. Refer to Section 01 34 00 for additional training requirements.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 92 00
PRESSURE TRANSMITTER

PART 1 - GENERAL

1.0 THE REQUIREMENT

A. The Contractor shall furnish, test, install, and place into satisfactory operation the pressure transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 10 00 – Process Control and Information Systems
B. Section 40 20 00 – Instruments, General

PART 2 - PRPDUCTS

2.1 PRESSURE TRANSMITTERS

A. Pipeline Pressure Transmitters
   1. Acceptable manufactures are:
      a. Emerson Rosemount 2088 Series
      b. Schneider Foxboro IAP/IAG Series
      c. ABB 266 series
   2. Power supply shall be 24VDC, powered from PLC panel power supply. Process connection shall be 1/2-inch female NPT flange adapter. Signal output shall be 4 to 20 mA.
   3. Pressure transmitter shall be capacitance or resonant-wire type. Unless otherwise specified, wetted parts shall be ASTM A276, type 316 stainless steel. Span shall be adjustable over a 6:1 or greater range. Over range capacity without affecting calibration shall be not less than 200 percent of maximum specified range. Volumetric displacement shall not exceed 0.01 cubic inch over the specified span. Fill fluid unless otherwise specified shall be silicone oil. Adjustable dampening shall be provided. External zero adjustment shall be provided. Accuracy shall be 0.25 percent of span or better for spans greater than 5 inches water column and 0.5 percent of span or better for spans less than or equal to 5 inches water column.
   4. Transmitter shall be provided with the following adjustable range:

Adjustable range of transmitter, water column	Span specified in the instrument schedule, water column
0.5 to 6 inches	0.5 to 5.5 inches
5 to 30 inches	5.5 to 27.5 inches
25 to 150 inches	27.5 to 137.5 inches
125 to 750 inches	137.5 to 750 inches

Higher ranges and spans shall be provided as specified in the instrument schedule. Transmitter for spans less than or equal to 25 psig shall be provided with one 1/2-inch flanged process connection and two 1/4-inch drain/vent ports, one plugged and one provided with bleed valve. Transmitter shall be provided with an evacuated sealed chamber and reference diaphragm shall be provided with a weatherproof, bug proof atmospheric vent. Transmitters for spans greater than 25 psig shall be similar except designed for gage pressure service, and overpressure rating shall be greater than the lesser of 2000 psig and 150 percent of maximum range.

B. Submersible Pressure/Level Transmitters
   1. Submersible Pressure transmitter shall be Keller Microlevel Microbore, or equal. Signal output shall be 4 to 20 mA. Transmitter outside diameter shall not exceed 0.63", unless transmitter fits within ¾" diameter pipe.
   2. Unless otherwise specified, wetted parts shall be ASTM A276, type 316 stainless steel drinking water grade. Accuracy shall be Static ±0.1% FS, Total Error Band ±0.25% BR.
   3. Transmitter shall be provided with Drying Tube Assembly optional accessory.
   4. Transmitter shall be provided with the following adjustable range: Relative Pressure Ranges shall be Infinite between 0...3 and 0...900 ft W.C.

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 40 20 00.

END OF SECTION

SECTION 40 15 10
PROCESS CONTROL STRATEGIES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. This section includes the process control strategies for this Contract. Together with the process input/output schedule, the equipment specifications (including control strategies for local equipment control panels), and the Drawings, the process control strategies describe the required operation, monitoring, and control of the facilities included in this Contract. The Contractor shall provide all equipment, and services necessary to implement all functions described herein.

B. The Contractor shall be responsible for furnishing functioning systems as described herein. The functional descriptions contain requirements for furnishing and installing labor and materials that may not appear elsewhere in the contract documents.

1.2 GENERAL DESIGN INFORMATION

A. Indicator lights on all MCCs, control panels, starter enclosures, interfaces, etc. shall conform to the following color convention:

Condition	**Color**
Running/Open	Green
Auto	White
Ready / Stopped / Off / Closed	Red
Fail	Red
Alarm	Red
Generic Status	Green, Blue or White

B. Running status shall be provided from auxiliary contacts provided with the motor starter. Auto status shall be defined as HOA or OA switch in Auto position. Ready status shall be defined as in remote or auto mode with all interlocks satisfied (no failure conditions present). Stopped and Off status shall be defined as all interlocks satisfied (no failure conditions present), except for no remote or auto mode. Failed status shall be defined as motor overload and/or any other shutdown mode such as over torque, over temperature, low oil pressure, high vibration, etc.

C. A discrepancy failure shall be indicated through the control system for any drive, motor, instrument, etc. that should be running or providing a reading but for which the PLC is not receiving a run status signal or valid reading. An example is a motor which is commanded to

run by the control system but is not subsequently detected as running. An adjustable time delay shall be provided for each motor to allow time for the motor to start and satisfy all interlocks.

D. Manual start/stop, open/close, speed/position adjustment, etc., from the Operator work stations shall be provided for all equipment controlled by the control system.
E. Where devices such as temperature, moisture, and/or vibration sensors, over- or under-pressure protection, space heaters, etc. are provided with process equipment and their associated motors under the various sections of Division 11, the Contractor shall provided all required interconnecting wiring between those devices and their associated MCCs, motor starters, VFDs, local control panels, etc.
F. Where setpoints, operating limits, and other control settings are provided by the process control strategies, these settings shall be initial settings only and shall be used for assistance in the initial startup of the plant. All such settings shall be fully adjustable, and based on actual operating conditions, the Contractor shall make all necessary adjustments to provide smooth, stable operation.
G. The control system shall be capable of receiving inputs of initial run-times for existing and proposed equipment. Initial run-time shall not automatically assumed to be zero.
H. All PLC control strategies shall return to a normal control mode upon restoration of power.
I. All setpoint control shall be by PID control algorithms. Where only proportional control is specified, tuning constants shall be used to reduce the integral and derivative functions to zero. All PLC-controlled variable speed equipment shall be provided with individual speed control PID modules in the PLC which shall be cascaded with the overall setpoint PID modules as required. All setpoints, sequence timers, sequence orders, dead bands, PID tuning parameters, PLC delay timers, variable speed operating range limits, and similar control constants shall be accessible and alterable from the Operator work stations.
J. All setpoints, alarms, etc. based upon an analog input signal or field variable shall be provided with time delays and dead bands to prevent nuisance tripping of controls and alarms.

K. Elapsed run time shall be determined through an auxiliary contract on the starter which is an input to the PLC.
    1. Elapsed run time shall be displayed at the SCADA level for each and every motor controlled through the PLC system.
    2. Individual elapsed run time accumulation may be reset by the operator after entering a password if the proper security level is associated with said password.
    3. Elapsed run time shall be displayed as 99,999.9 hours after which the elapsed run time registers shall recycle to 0.0 hours.
    4. Provisions shall be made to allow the operator to enter a start value for runtime accumulation.
    5. Elapsed run time shall be accumulated and stored in PLC registers and not in the SCADA

system.

L. PID control algorithms.
   1. PID control algorithms shall have operator selectable slew rates for setpoints that will allow the setpoint to slowly ramp to its final value in order to minimize system disturbance.
      a. Individual setpoint slew rates shall be set at a local HMI if available as well as through the SCADA system.
   2. Each PID control algorithm shall have a face plate associated with the individual PID control algorithm that shall be displayed at its associated HMI and at the SCADA terminal. Said face plate shall have the following functions:
      a. Display Output, CV.
      b. Display Setpoint, SP.
      c. Display Process Variable, PV.
      d. Allow for operator selection of Automatic or Manual control of Output.
      e. Under manual control of output allow the Operator to enter the desired output value.
      f. Allow for input of the three PID tuning parameters.

M. Programmable settling and proving timers shall be provided in all control sequences for starting and stopping of pumps, in order to let the process settle down before proceeding with any additional control functions.
   1. These timers shall be imbedded in the PLC logic, tuned in the field, and listed separately as part of the software submittal and O & M manual.

N. Status indication:
   1. The associated pilot light, HMI display, and SCADA display for each valve and pump shall indicate valve or slide gate position if available by constantly illuminating the corresponding status indication and report this condition to the SCADA system.
   2. As previously described a fault condition shall flash the associated status indicator and alarm within the SCADA system.
   3. When a valve is in transition, not fully closed and not fully opened, then the valve open and valve closed status indicator shall:
      a. For HMI and graphic displays state that the valve is in transition.
      b. For pilot lights shall alternately flash on and off the valve fully opened and fully closed pilot lights.

O. When setpoints or actions are identified to occur on more than one HMI, or both the HMIs and SCADA, the last action or setpoint shall override the current condition, unless otherwise noted.

P. Control software and/or hardware shall be so configured and designed as to monitor for loss of analog signal (signal <4 mA), analog signal too large (signal > 20 mA), or rate of signal change too fast (individual rate parameter for each analog input signal to be imbedded in software), when any of these conditions are detected the control system shall alarm this condition, and close the appropriate valve and or stop the appropriate motor in order to prevent the process from running away.

Q. The manual control mode shall be completely manual and under the operator control, there shall be no programmed interlocks requiring completion of a previous step before operating a device, unless specifically identified in the individual loop descriptions as occurring in the manual mode.

R. Number of starts shall be accumulated for each motor.
   1. The number of starts for the current day shall be moved into a register and held as the previous day's number of starts at 0:01 hours each day.
   2. The number of starts for the current day shall be entered into the historical data base time and date stamped at 0:01 hours each day.
   3. The current day number of starts shall be reset at 0:01 hours each day.

S. Alarm/Fault Indication/Acknowledgement
   1. Furnish an alarm acknowledgement pushbutton at each VCP, HMI, or LCP that shall signal the PLC that an alarm or fail condition has been acknowledged. This device shall only affect the alarms that are present on the panel where the device is located.
   2. In general any fault condition shall flash the appropriate pilot light and/or graphic at a rate of on for 0.5 seconds and then off for 0.5 seconds.
   3. The individual alarm acknowledgement pushbutton or action shall function as follows:
      a. Shall change the flashing alarm indication to continuously ON if the alarm or fail condition persists after the acknowledgement button or action has been depressed.
      b. Shall turn OFF the alarm indication if the alarm or fail condition has been corrected and the alarming system has returned to normal.
   4. An alarm beacon and horn shall be located as needed.
      a. The alarm silence pushbutton or HMI command shall silence the horn but continue to show the visual alarm.
   5. All alarm and fail conditions shall flash their respective pilot lights, indicators, HMI, or SCADA graphics, until the condition is acknowledged by the operator.
      a. Once the operator acknowledges the alarm or fail condition the pilot light, indicator, HMI, or SCADA graphic shall remain ON in a steady condition.
      b. Once the alarm has been cleared and the operator again acknowledges the alarm or fail condition the pilot light, indicator, HMI, or SCADA graphic shall turn

OFF.

6. All valves, pumps, motors, and other process equipment shall have fail alarms displayed and reported at the HMI and SCADA level.

T. Tank and vessel levels.
   1. All tank and vessels levels shall be displayed both in feet (XX.XX) and gallons, whether or not specifically identified in the P & IDs or Loop descriptions.
   2. All identified tanks and/or vessels that have a level measurement shall include, whether or not identified, the following minimum functions that shall be displayed on the associated HMI and SCADA System.
      a. Numerical readout of process material level in the tank.
      b. Setpoint for high level and high level alarm
      c. Setpoint for low level and low level alarm.
      d. Setpoints for high level and low level shall be entered as a level or volume as directed by the ENGINEER.

U. Power failure.
   1. The control system upon sensing a power failure shall store, within, the PLC memory the current accumulation of all time records and flow totals and as necessary, the status of all devices, i.e. ON or OFF, to allow a return to normal operating condition.

V. PLC System Status
   1. There shall be a minimum of one screen that shall include the status of all PLCs in the system and the status of the PLC communications LAN.
   2. The PLC shall monitor communications status with equipment including with heartbeat status and alarm on communications failure.

W. Analog device calibration override.
   1. Provide a SCADA screen for each and every analog input that allows the Operator to access said analog input to:
      a. Disable the analog input in the PLC control system.
      b. Enter a value for the analog input from the SCADA system to the PLC.
      c. Hold the last analog input value while the actual analog input is disabled.
   2. Provide a SCADA screen for each and every analog output that allows the Operator to access said analog input to:
      a. Force an output value entered from the SCADA system to the PLC.
      b. Hold the last analog output value while the programmed output is disabled.

PART 2 - PRODUCTS

2.1 CONTROL DESCRIPTION

A. The drinking water system for the purposes of this project consists of a well pump that draws water from a well and directly feeds the drinking water system. The water when starting is pumped to waste (i.e. storm drain). There is a gas chlorination system that introduces chlorine gas to a boosted stream of water and correctly doses the right amount of chlorine into the egress line.

B. Under normal operation, the well pump controls to a desired pressure setpoint. There is a maximum flow rate limit setpoint for the system.

C. The control system shall permit the manual operation of the well pump and valves and all necessary auxiliaries to pump water to the drinking water system, all without the requirement of the PLC. The PLC will have more sophisticated I/O and algorithms available for advanced monitoring, controls, and alarms, but the well must run independently without the need of the PLC using manual controls on the control panel, and manual operation/monitoring of valves, equipment, etc.

D. This control description does not cover all requirements from the City for standard HMI screens, operator interface and overrides, which data to display on the HMI, etc. Refer to City for standards.

2.2 AUTOMATED WELL STARTUP SEQUENCE

A. The waste valve is held waiting in the open position.

B. The Well startup sequence begins when the control switch is set to Auto and the PLC sends a Run command. The pre-lube water solenoid opens the solenoid and upon detection of flow from the flow switch, begins a 10 minute timer. If there is no flow detected within a set time, an alarm is generated and the pump shuts down and locks out.

C. During the pre-lube cycle, if the waste valve is not in the open position, the system prepares for a flush by opening the waste valve. If the valve does not show open during the lube cycle, it will alarm and shut down.

D. Once the 10 minute pre-lube cycle is complete and the valves are detected to be in the correct position for a flush, the VFD to the Well Pump is commanded to run. The pre-lube water continues to be delivered for the first 2 minutes of runtime.

E. The flushing cycle will continue until the timer completes its cycle. The PLC can extend the waste cycle beyond the hard-wired timer. At the conclusion of the flushing cycle, the waste valve will begin to close. The pressure on the check valve will eventually allow water to pass to the system.

F. The VFD speed will be adjusted by the controller to maintain the normal water delivery pressure setpoint. There is a maximum flow rate limit setpoint for the system.

G. The controller speed setpoint to the VFD will be calibrated in the VFD so that 4mA will correspond to the minimum acceptable VFD speed, and 20mA will be the maximum acceptable VFD speed. This will be field-verified as to the minimum and maximum speeds. The VFD will not interpret 4mA as a zero speed, and 20mA as a maximum speed, but will rather function as aforementioned.

H. All setpoints and timers used in the PLC for control shall be adjustable by the operator via the HMI interface.

2.3 MANUAL WELL STARTUP SEQUENCE

A. The waste valve is held waiting in the open position.

B. The pre-lube water solenoid opens the solenoid and upon detection of flow from the flow switch, begins a 10 minute timer. If there is no flow detected within a set time, an fault condition is generated and the pump shuts down and locks out. During the pre-lube cycle, the operator confirms the correct position for a flush.

C. Once the 10 minute pre-lube cycle is complete the VFD to the Well Pump will automatically start. If the PLC is functioning, the pre-lube water continues to be delivered for the first 1 minute of runtime, otherwise the lube solenoid will close when the run status is seen back from the VFD controller.

D. The waste valve will be fully open as indicated on the VFD controller LED, and the operator will manually control the VFD speed via a speed pot on the control panel, and attempt to control to a predetermined frequency to prevent overcurrent. If no flow is seen by the operator after a reasonable amount of time, the operator switches the controller to the OFF position.

E. At the conclusion of the flushing cycle as determined by the waste timer (operator adjustable), the waste valve closes, the flows will be redirected to the system piping. The operator will adjust the VFD speed via the speed pot on the controller to the desired pressure setpoint, limited to a maximum flow.

F. It is the controllers responsibility to monitor for turbidity and to interrupt passing turbid water to the system. It is the controller's responsibility to monitor well levels and to shut down the pump on low-low level.

G. The PLC (if functioning) continues to monitor conditions and provide alarms. The PLC has an input to indicate when the controls are in Auto. When not in Auto, the PLC does not attempt to perform any pump or valve control, but does still send a lube command for 2 minutes following the start of the well pump, and chlorination solenoids and booster pump.

2.4 WELL PERMISSIVES

A. The Well Pump will shut down and/or not allow startup for any of the following

conditions:

1. Hardwired:
   a) High discharge pressure as detected by the high discharge pressure switch, or the discharge pressure transmitter reading a high signal. The discharge pressure transmitter alarm will have a time delay adjustable in the system. The high discharge pressure switch will either be selected by hardware to be properly delayed and debounced for momentary high pressures during startup, or if it does not have the capability, then the controller will provide the appropriate debounce delay. This condition will lock in the shutdown and require a reset to resume operation of the pump.
   b) Low well level will shut down the pump. This condition will lock in the shutdown and require a reset to resume operation of the pump. An alarm will register for a Low well level. A low level shutdown bypass switch on the cabinet allows the operator to continue pump operation in the event of a level transmitter failure.
   c) High motor temperature will shut down the pump. This condition will lock in the shutdown and require a reset to resume operation of the pump.
   d) VFD Failure will shut down the pump. This condition will lock in the shutdown and require a reset to resume operation of the pump.
   e) Pre-lube failure will prevent startup of the pump. This condition will lock out the permissive and require a reset to resume operation of the pump. Upon resuming, the startup sequence restarts from the beginning requiring the full 10 minute timer to elapse before starting the pumps.
   f) The operator places the control hand switch in the OFF position or E-STOP is depressed. This switch will electrically drop the run command to the VFD. The E-STOP will kill power to all signals.
   g) The HMI will have the capability to cause an Emergency Stop or a stop command.
2. PLC:
   a) Low water flow as measured by the well pump discharge flowmeter will shut down the pump.
   b) Failure of the valves to be in the correct position for the current cycle (flushing or normal) will on a time delay prevent startup or cause a shutdown of the pump. This condition will lock out the permissive

and/or lock in the shutdown and require a reset to resume operation of the pump.

c) The PLC will detect that the hand switch is not in AUTO and drop the run command in the controller.

d) Well level pressure transmitter failure will shut down the pump.

2.5 WELL SHUTDOWN SEQUENCE

A. A normal stop will slow the VFD Via the PLC and then completely stop. It will not be permitted to slow down more abruptly than the rate set in the VFD configuration.

B. An operator stop will involve the operator switching the controller to the OFF position.

C. A Hard shutdown stop or E-Stop, the run command to the VFD will drop which will cut power to the pump which will stop on its own with mechanical ratcheting. All valves will remain in their current position.

2.6 WELL COOLDOWN SEQUENCE

A. The Well pump shall not be permitted to restart until 10 minutes have gone by following a shutdown, with a maximum number of starts being limited to 4 per hour.

2.7 CHLORINE SYSTEM

A. Safety:

1. A Chlorine Gas detector is installed in the Chlorine room. The PLC will monitor the chlorine levels and alarm on high levels. On high-high levels, the PLC will also alarm, and a corresponding switch within the detector will hardwire into a gas alarm panel that will turn on the vent fan, and illuminate two gas beacons. The hardwired gas alarm latches in the gas alarm panel.

2. Power OK is sent to the PLC so that the PLC can alarm if the gas alarm panel circuit loses power. Fail safe so loss of power or open circuit in the input alarms the PLC.

3. Gas Detector Fault produces an alarm in the PLC.

4. The Chlorine room vent fan will start when the lights of the room are turned on (via switch), or the fan switch is turned on, or when the room temperature exceeds 80 deg F.

B. Dosing:

1. The chlorine system has a manual regulator that is set to deliver the right amount of gas into the flowing water stream as delivered by the booster pump.

2. The booster pump is commanded ON when the water is being pumped, and it is not in a flush cycle. The booster pump will be OFF during flush cycles, and any time the waste valve is sensed open.

3. Operators can disable the chlorination via the booster pump through its HOA switch, circuit breaker, and by manual valves.

4. The Chlorine analyzer alarms on High or Low chlorine levels.

2.8 WATER LUBE SYSTEM

A. Operation:

1. The water lube booster pump will operate based on pressure and fill a water storage tank. A deadband pressure switch will start and stop the pump.
2. The water storage tank provides water lube for well operation and water supply for spray-down purposes. The maximum flow provided by the pump shall not exceed the outlet flow of the storage tank. This will prevent frequent on and off cycling of the pump during water usage.
3. The starter will provide running status to the PLC.

2.9 ADDITIONAL I/O ALARMS AND CONTROLS

A. Master Reset:

1. The VFD will lock in its alarms and fault conditions, and the PLC will lock in shutdown conditions. A single Master Reset pushbutton will clear all VFD alarms and fault conditions, and indicate to the PLC to reset its shutdown conditions.

B. PLC I/O, Control, and Alarms:

1. DO Start Pump: Request to run the pump is sent. This should not be sent unless all PLC conditions are satisfied.
2. DO Waste Open CMD: Request to open the Waste valve. Sent when the pump is Off. Sent during a flush cycle (triggered by start of pump). Dropped when the "OPEN" status is received. Alarm if open command without open status in time delay while in AUTO.
3. DO Lube CMD: Request to open Lube Water. FAIL OPEN. Lube on start request in code, and Start Pump DO. Timer adjustable on HMI. Send command also for 2 minutes after run status comes in.
4. DI VFD In Auto: When in AUTO, PLC Performs all the control decisions with the information it has. VFD still handles key hardwired safety lockouts, but communicates lockouts with the PLC. This should continue to be used in the PLC as well to shutdown, and latch the shutdowns. When not in Auto, PLC should drop the Start Pump Command and any Waste valve commands, no speed reference should be sent (4mA).
5. DI Pump Running: Indicator and trigger for HMI graphics. Alarm if run command and no run status after delay while in AUTO.
6. DI Hi Press: Indicator and trigger for HMI graphics. Alarm and locked shutdown AUTO or not.
7. DI Hi Temperature: Indicator and trigger for HMI graphics. Alarm and locked

shutdown AUTO or not.

8. DI Lube Fail: Alarm and locked shutdown AUTO or not.
9. DI VFD Fault: Alarm and locked shutdown AUTO or not.
10. DI E-STOP Engaged: Alarm and locked shutdown AUTO or not. Also all outputs go to safe state AUTO or not.
11. DI Waste Valve Open Status: Indicator, and trigger for HMI Graphics. Do not send start until open, but once started it is not a shutdown.
12. DI Waste Valve Close Status: Indicator, and trigger for HMI Graphics. Do not send start until open, but once started it is not a shutdown.
13. DI System Valve Open Status: Indicator, and trigger for HMI Graphics.
14. DI System Valve Close Status: Indicator, and trigger for HMI Graphics.
15. DI PLC Reset DI: Master Reset button input from control panel. Locked-out shutdowns release. This does not reset the PLC or counters or timers or totalizers.
16. DI Generator PR-Alarm: Indicates that a pre-alarm is triggered.
17. DI Generator Running: Indicates running status of the generator.
18. DI Generator Not in Auto: Indicates that HOA Auto is selected.
19. DI Generator Failure: Indicates failure status of the generator.
20. DI ATS Normal Position: Indicates ATS normal selection position.
21. DI ATS Standy Position: Indicates ATS standby selection position.
22. DI ATS Transfer Inhibited: Indicates that ATS transfer was unsuccessful.
23. AO Pump Speed CMD: PID controller during flush cycle controls to a predetermined frequency to prevent overcurrent. Separate PID controller during normal cycle controls to discharge pressure. Start ramp per HMI-accessible max start ramp rate. Stop ramp per HMI-accessible max stop ramp rate.
24. AI Pump Speed REF: Indicator and data for HMI. Alarm on mismatch with delay while in AUTO.
25. DI PLC Power Fail: Relay drops power when PLC Cabinet loses primary power. Secondary power (UPS) continues. Alarm AUTO or not.
26. AI Well Level: Indicator and data for control panel. Alarm and shutdown on low Well Level.
27. DI Pump Rm Flood: Alarm AUTO or not.
28. DI CL2 Rm Flood: Alarm AUTO or not.
29. AI Discharge Pressure: Indicator and data for HMI. Alarm and locked shutdown on High pressure after timer. During normal operation while in AUTO, used to control VFD speed to pressure setpoint.
30. AI Lube Water Flow: Alarm and locked shutdown low flow with HMI-accessible delay during lube cycle in AUTO or during Lube command AUTO or not.
31. AI Well Flow Rate: Indicator and data for HMI. Historize. Totalize based off communications with flow meter. Separate totalizers when running to system from when running to waste. Open is trigger for waste totalizer.
32. DI Booster Pump Run Status: Information and data to HMI. Alarm on command/status mismatch AUTO or not.
33. DO Booster Pump Run Command: See CHLORINE SYSTEM Dosing strategy for booster run philosophy. Alarm on command/status mismatch AUTO or not.
34. DI Water Booster Pump Run Status: Information and data to HMI.

35. AI CL2 Tank Weight: Information and data to HMI. Alarm on low tank weight.
36. AI CL2 Tank Weight: (tank 2) Information and data to HMI. Alarm on low tank weight.
37. DI Low Well Level: Indicator and trigger for HMI graphics. Alarm and locked shutdown AUTO or not.
38. AI Pump Room Temperature: Information and data to HMI. Alarm on high/low temperature. High > 40 deg C (104 deg F). Low < 5 deg C (40 deg F).
39. AI CL2 Room Temperature: Information and data to HMI. Alarm on high/low temperature. High > 40 deg C (104 deg F). Low < 5 deg C (40 deg F).
40. DI Intrusion Alarm: Alarm on intrusion.
41. DI Meter Vault Intrusion Alarm: Alarm on intrusion.
42. DI Tank Intrusion Alarm: Alarm on intrusion.
43. AI CL2 Gas Detector: Information and data to HMI. Alarm on high CL2 Gas. Alarm on high-high CL2 Gas. Coordinate with switch on gas detector. Both alarms should occur prior to switch causing beacons and vent fan response. See also CHLORINE SYSTM Safety strategy.
44. DI CL2 Panel Power Ok: Alarm when not OK.
45. DI CL2 Gas Alarm: Alarm when initiated. Lock alarm. Display on HMI.
46. DI Gas Detector Fail: Alarm when initiated. Lock Alarm. Display trouble on HMI.
47. AI Meter Vault Pressure: Indicator and data for HMI. Alarm on High pressure after timer.
48. AI Meter Vault Pressure: Indicator and data for HMI. Alarm on High pressure after timer.
49. AI Tank Flow Rate: Indicator and data for HMI. Historize. Totalize based off communications with flow meter. Separate totalizers when running to system from when running to waste. Open is trigger for waste totalizer.

END OF SECTION

SECTION 40 20 00
INSTRUMENTS GENERAL

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, install, test, and place in operation process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface with all instrumentation, panels, controls, and process equipment control panels with the process control system as shown on the Drawings and as specified. Mounting of associated transmitters, indicators, power supplies, brackets, and appurtenances shall be provided as specified herein and shown on the Drawings.

B. It is the intent of this Specification and the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of the process instrumentation on process lines shall be provided under this Contract.

C. Taps and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. It is the Contractor's responsibility to ensure that the location, supports, orientation, and dimensions of the connections and taps for instrumentation as such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 10 00 – Process Control and Instrumentation Systems

B. Division 26.

1.3 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ISA S20	Specification Forms for Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology

1.4 GENERAL INFORMATION AND DESCRIPTION

A. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment furnished. They are, however, intended to cover the furnishing, the shop testing, the delivery, and complete installation and field testing of all instruments and appurtenances whether specifically mentioned in the Specification or not.

B. The instruments shall be furnished and installed with all necessary accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not. The installations shall incorporate the highest standards for the type of service shown on the Drawings including loop testing of the entire installation and instruction of operating personnel in the care, operation, calibration, and maintenance of all instrumentation.

C. All instrumentation shall be of first-class workmanship and shall be entirely designed and suitable for the intended services. All materials used in fabricating the equipment shall be new and undamaged.

PART 2 - PRODUCTS

2.1 GENERAL

A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, all instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.

B. Equipment installed in hazardous areas shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electric Code.

C. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.

D. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in paragraph 3.1.B. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable, except for speed and valve position. Floating outputs shall be provided for all transmitters.

E. Unless otherwise specified, field instrument and power supply enclosures shall be 316 stainless steel, fiberglass, or PVC coated copper free cast aluminum NEMA 4X construction.

F. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.

G. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture, and fungus. Solid-state components shall be conservatively rated for long term performance and dependability over ambient atmospheric fluctuations. Ambient conditions shall be –15 to 50 degrees C and 10 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.

H. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.

I. All non-loop powered instruments and equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage reduction, constant voltage transformers shall be supplied.

J. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.
K. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials is available.

2.2 INSTRUMENT LIST

A. The instrument index, attached as an appendix to this section, lists major instruments required to provide the process instrumentation system. All instrument functions specified on this list shall be provided by the Contractor. Additional instruments may be required to complete the instrument loops because of certain characteristics of the particular equipment selected by the Contractor. Such additional instruments shall be provided at no additional cost even though not specified in the instrument index or on the contract drawings.

2.3 ACCESSORIES

A. Isolation Valves – Valves shall be full port ball valves with ASTM A276, Type 316 stainless steel trim and body and with Teflon seats and packing. Valves shall be Parker CPI, Whitey, Hoke, or equal.
B. Gage Valves – Gage valves shall be machined from ASTM A276 bar stock and shall be provided with 1/2-inch NPT connections and integral bleed valve. Valves shall be Anderson, Greenwood & Company M9530, Hoke 6801L8Y, or equal.
C. Root Valves – Root valves shall be ASTM A276, Type 316 stainless steel bar stock with 1/2-inch NPT male process connection and three 1/2-inch NPT female instrument connections. One instrument connection shall be provided with an ASTM A276, Type 316 stainless steel bleed valve. ASTM A276, Type 316 stainless steel plugs shall be provided for unused ports. Lagging type units shall be provided for insulated vessels and pipes. Root valves shall be Anderson, Greenwood & Company M5 AVS-44, Hoke 6802L8Y, or equal.
D. Manifolds – Manifolds shall be three-valve bar-stock type. Manifold body shall be machined from 316 stainless steel bar stock. Valves shall be globe configuration with 316 stainless steel ball seats and Teflon stem packing. Manifolds shall be designed for direct mounting to differential pressure transmitters in place of the flanges normally furnished. Fabricated manifolds or manifolds employing needle or soft seat valves are not acceptable. Purge taps, 1/8-inch NPT shall be furnished on manifolds where water purge is specified. Manifolds shall be Anderson Greenwood M4TVS, Hoke 8123F8Y, or equal.
E. Tubing – Instrument tubing between the process connection and instruments shall be 1/2-inch x 0.065-inch seamless annealed ASTM A269, Type 316 stainless steel. Tubing fittings shall be Type 316 stainless steel. Fittings shall be of the swage ferrule design and shall have components (nut, body and ferrule system) interchangeable with those of at least one other manufacturer. Flare and ball sleeve compression type are not acceptable. Fittings shall be Parker CPI, Crawford Swagelok, Hoke Gyrolok, or equal.
F. Chemical Seals

1. Diaphragm – Seal shall be the diaphragm type with flushing connection, Type 316 stainless steel body and Type 316L diaphragm unless otherwise specified. Seal shall be Mansfield and Green Type SG, Ashcroft Type 101, or equal.
2. Annular Ring – Seal shall be the in-line full stream captive sensing liquid type. Metallic wetted parts shall be Type 316 stainless steel. Flexible cylinder shall be Buna-N unless otherwise specified. Seals shall be rated 200 psig with not more than 5-inch WC hysteresis. Seals shall be Ronningen-Petter Iso-Ring, Red Valve series 40, or equal.
3. Fill Fluid – Chemical seals and associated instruments shall be factory filled as follows: Instrument side of seal, capillary tubing, and instrument shall be evacuated to an absolute pressure of 1.0 Torr or less; filled; and sealed. Unless otherwise specified, fill fluid shall be silicone oil, Dow Corning DC200, Syltherm 800, or equal.

G. Bushings and Thermowells – Bushings or thermowells shall comply with SAMA PMC17-10. Temperature taps shall be 1/2-inch NPT, and lagging extensions shall be provided on insulated vessels or pipes. Thermowells and bushings shall be machined from Type 316 stainless steel bar stock unless otherwise specified.
H. Purge Assemblies

1. Air – Air purge assembly shall consist of a constant-differential relay, needle valve, check valve and 0.2 to 2.0 scfh rotameter. Assembly shall be Moore Products 62VA, Fischer & Porter 10A3137N-3BR2110, or equal.
2. Water – Water purge assembly shall consist of a strainer, constant-differential regulator, needle valve, check valve, and 20 to 200 cc/m rotameter. Assembly shall be Moore Products 63BD4A, Fischer & Porter 10A3137N-53BR2110, or equal. Strainer shall be 155 micron wye-type, ASCO 8600A2, Crane, or equal.

2.4 POWERED INSTRUMENTS GENERAL REQUIREMENTS

A. Powered instruments are those instruments which require power (120 VAC or 24 VDC loop power) to operate. Each instrument includes an element or analyzer and a transmitter/controller.
B. Transmitters shall be 4 to 20 milliampere output two-wire type with operating power derived from the transmission circuit. Transmitter shall support an external load of 0 to 600 ohms or greater without requiring trimming resistors with a transmission circuit power supply of 24 volts. Transmitter output shall be galvanically isolated from the process and the transmitter case. Time constant of transmitters used for flow or pressure measurement, including level transmitters used for flow measurement, shall be adjustable from 0.5 to 5.0 seconds. Transmitter output shall increase with increasing measurement except where "reverse action" is specified in the instrument schedule.
C. Electrical parts of transmitter and/or primary element mechanisms shall, as a minimum be housed in enclosures meeting NEMA 250, Type 4 requirements. Where electrical mechanisms are located outdoors or in areas specified as corrosive, enclosures shall meet NEMA 250, Type 4X requirements.
D. Transmitters located outdoors shall be provided with surge protectors: Rosemount Model 470A, Taylor 1020FP, or equal.

E. Where two-wire transmitter is located in an area classified as hazardous, it shall be made safe by means of an intrinsic safety barrier. Intrinsic safety barriers for two-wire transmitters shall be of the active, isolating, loop powered type. Barrier shall be Measurement Technology LTD. type MT3042, Stahl 9005/01-252/100/00, or equal.

F. Where four-wire transmitters are permitted, they shall be provided with a loop powered signal current isolator connected in the output signal circuit. Isolator shall provide galvanic isolation of milliampere transmission signals from transmitters with inadequately isolated output circuits. Isolator shall be housed in a NEMA 250, type 4/7 conduit body and shall derive its operating power from the signal input circuit. Input and output signals shall be 4 to 20 milliamperes, and error shall not exceed 0.1 percent of span. Input resistance shall not exceed 550 ohms with an output load of 250 ohms. Isolator shall be Moore Industries SCX/4-20MA/ 4-20/MA/6.5DC/-RF(EX).

PART 3 - EXECUTION

3.1 INSTALLATION

A. General – Equipment shall be located so that it is accessible for operation and maintenance. Electrical work shall be performed in compliance with all applicable local codes and practices. Where these specifications and the Drawings do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.

B. Equipment Mounting and Support

1. Field equipment shall be wall mounted or mounted on two-inch diameter aluminum pipe stands welded to a 10-inch square, ½-inch thick aluminum steel baseplate. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than ½-inch by use of phenolic spacers. Expansion shields in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
2. Embedded pipe supports and sleeves shall be schedule 40, 304 stainless steel pipe, with stainless steel blind flange for equipment mounting as shown on the Drawings.
3. Materials for miscellaneous mounting brackets and supports shall be 304 stainless steel.
4. Pipe stands, mounting brackets, and supports shall comply with the requirements of Division 5.
5. Where transmitters are supported from process piping, leveling saddles shall be provided. Transmitters shall be oriented such that output indicators are readily visible.

C. Control and Signal Wiring – Electrical, control, and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

3.2 CLEANING AND ADJUSTMENT

A. General

1. The Contractor shall comply with the requirements of Division 1 and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserve the right to witness any test, inspection, calibration, or start-up activity. Acceptance by the Engineer of any plan, report, or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.
2. The Contractor shall provide the services of factory trained technicians, tools, and equipment to field calibrate, test, inspect, and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provided all personnel, equipment, and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

B. Field Instrument Calibration Requirements

1. Each instrument shall be calibrated at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracies as set forth by the National Bureau of Standards.
2. The Contractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures, name of person performing the calibration, listing of published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required, and corrections made.
3. If doubt exists as to the correct method for calibrating or checking calibration of an instrument, the manufacturer's recommendations shall be used as an acceptable standard, subject to approval of the Engineer.
4. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices being subjected to overvoltages, incorrect voltages, overpressures, or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.
5. Upon completion of instrumentation installation, the Contractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 40 21 20
MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install, and place into satisfactory operation the magnetic flowmeter systems, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 10 00 – Process Control and Information Systems

B. Section 40 20 00 – Instruments, General

PART 2 - PRODUCTS

2.1 MAGNETIC FLOWMETERS

A. Acceptable Manufactures are:
   a. Siemens Sitrans FM Flowsensor MAG 5100 W, ETHERNET CAPABLE, DN 200 (8”), 115VAC Power Supply
   b. No substitutes

B. Process connections shall be cast iron flanged, ANSI B16.5, Class 150, raised face.

C. Magnetic flow meter shall be provided as a system consisting of a flow tube and separate converter/ transmitter complete with interconnecting cables. Converter/transmitter shall be suitable for full-scale flow rates from 3.0 to 30 feet per second. System error shall not exceed the greater of 0.5 percent of rate or 0.1 foot per second. Flow Range Capacity from 10 gpm to 2,000 gpm. Flow tubes located in lined or non-conductive pipelines shall be provided with grounding spools or swages fabricated from ASTM A312, Type 316 stainless steel. Grounding spools or swages inside diameter shall be 1/16 inch smaller than flow tube inside diameter. Where pipe run size is different from specified flow tube size, uniformly diverging swages with a total angle between walls not exceeding 15 degrees shall be provided. Excitation power requirements shall not exceed 100 volt-amperes.

D. Flow tubes size 0.5 through 6 inches shall be ceramic lined wafer-style ductile-iron body with 316 SS electrodes. Flow tubes larger than 6 inches shall be cast aluminum full-body flanged construction with 316L stainless steel electrodes. Unless otherwise specified, liner shall be polyurethane.

E. The transmitter shall contain all electronics associated with the magnetic flow meter system. Enclosure shall be NEMA 4 cast aluminum compartment for power, field connections and calibration adjustments separate from digital circuitry. Transmitter shall contain means to calibrate the metering system without use of external calibration units. The transmitter shall contain self-diagnostics and shall be interchangeable with other units of the same type without special re-calibration. Transmitter shall include an integral 3-digit LCD flow indication calibrated in process units. Adjustable dampening shall be provided. Provision for accepting an external contact to force signal output to zero shall be provided. Where pulse frequency output is specified, pulse frequency shall cut out at flows below 2 percent of maximum range. The signal cable between the primary element and transmitter shall be provided by the system manufacturer. Provide encapsulation with sufficient length of cable for installation of a continuous run between the primary element and the transmitter. Roll up excess in panel.

F. Remote mounted display/transmitters shall be provided where indicated on the drawings. Flow tubes with integral display/transmitters shall be provided where indicated on the drawings.

G. Totalized flow shall be communicated via Ethernet cable to the PLC. Meter shall show flowrate in gpm and total in 1,000 gallons.

H. Magnetic flow meter shall be capable of meeting the specified accuracy requirement with five lay lengths upstream and two lay lengths downstream from the meter.

I. System and liner shall have drinking water certification.

J. Stainless steel grounding rings shall be supplied.

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 40 20 00.

END OF SECTION

SECTION 40 27 10
LIQUID LEVEL SWITCHES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install, and place into satisfactory operation the liquid level switches with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 10 00 – Process Control and Information Systems
Section 40 20 00 – Instruments, General

PART 2 - PRODUCTS

2.1 LIQUID LEVEL SWITCHES

A. Level Switch Tipping Float
   1. Device identification: See Section 40 20 00.
   2. Float actuated switch shall be a dry contact type switch in a hermetically sealed polypropylene casing, suspended on a PVC coated cable.
   3. The number of floats per level system shall be as shown.
   4. The switch rating shall be at least 10 amps at 120 VAC.
   5. Switch set points shall be as shown on the drawings.
   6. Mercury switch type capsules are not allowed.
   7. As manufactured by:
      a) WE Anderson/Dwyer FSW Series
      b) Or approved equal

B. Room flood monitoring switches
   1. Device identification: See Section 40 20 00.
   2. Stem and mounting shall be 304 Stainless Steel.
   3. The float shall be Buna N material.
   4. The wetted parts shall be manufactured of Beryllium Copper, Copper Nickel, or Polycarbonate.
   5. Dry contact with an electrical rating of 20VA.

6. Operating Temperature of -40 F to 140F.
7. Gems Sensors LS-270 or approved equal.

C. The CONTRACTOR shall deliver to the OWNER all required spare parts. The spare parts shall not be used as replacement parts during system start-up or the guarantee period.

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. See Section 40 20 00.

END OF SECTION

SECTION 40 27 60
PRESSURE SWITCHES AND SEALS

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install, and place into satisfactory operation the pressure switches and seals with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 MANUFACTURERS

A. Section 40 10 00 – Process Control and information Systems

B. Section 40 20 00 – Instruments, General

PART 2 - PRODUCTS

2.1 Pressure Instrumentation

A. Seals

1. All pressure switches and/or transmitters shall be provided with seals.
2. Pressure switches, gages, and/or transmitters and seals shall be assembled and oil filled at the factory prior to shipment. Filling fluid shall be compatible with piping contents and temperature.
3. Pressure switches and/or transducers attached to systems involving chemical solutions, corrosive fluids, or other liquids containing one percent or more of solids, shall be equipped with diaphragm or annular seals whether shown or not on the drawings, or equal protective pressure sensing devices, as follows:

a) Clear process water applications:

1. Type 316 stainless steel for pressures over 15 psi.
2. Elastomer for pressures of 15 psi and below.
3. Type 316 stainless steel nuts and bolts, fill connection and valved flush port size of ¼-inch NPT, capable of disassembly without loss of filler fluid.
4. As manufactured by:
   a) Ashcroft Type 101
   b) Or prior approved equal.

b) For chemical solutions, sludge, etc., where breakage does not create major shutdown:

1. Seals with PVC body for removable mounting rated at 200 psi.

2. Type 316 stainless steel bolts and nuts
3. ½-inch inlet
4. ¼-inch outlet
5. Liquid-filled with Teflon diaphragm for pressure.
6. Elastomer diaphragm for vacuum service.

c) For sludge, liquids containing solids, pulsating flow:

1. Pressure instrument protectors shall be of the isolation ring type seal with integral instrument removal device.
2. Construction
   a. Unit consists of a body, 360 degree flexible elastomeric cylinder with positive O-ring type sealing arrangement, captive fill fluid and two assembly flanges.
   b. Includes integral instrument removal device to remove instrumentation without interrupting process flow. The isolation ring I.D. shall match the pipeline I.D. The isolation ring O.D. shall not exceed the I.D. of the piping flange bolt circle. Units are designed to fit 135#, 150# and 300# ANSI piping flanges.

3. Materials
   a) Body is 316 Stainless Steel unless otherwise required. Two assembly flanges are 316 S.S. Flexible elastomeric cylinder is Silicone. Captive sensing liquid is glycerin, Silicone or Halocarbon as required for the piped fluid.
4. As manufactured by:
   a) Ashcroft Type 80, 81.
   b) Prior Approved Equal.

2.2 Pressure Switches High

a) General:
   1) Enclosure NEMA 4X
   2) Manual Reset trip on increasing pressure
   3) DPDT
   4) Actuator Seal: Teflon
   5) Each pressure switch shall have visible scale and contact operation.

b) Pressure switches shall have a contact rating of 10 amperes at 125 VAC.

c) Pressure switches shall be snap-action switches and shall be in general-purpose enclosures at indoor installations, or weatherproof enclosures at outdoor installations.
d) Diaphragm seals shall be provided and included at the locations shown.
e) Automatic reset
g) Standard Ranges:
1) 10” H20, Proof psi 20, Burst psi 35
2) 30” H20, Proof psi 20, Burst psi 35
3) 60” H20, Proof psi 20, Burst psi 35
4) 100” H20, Proof psi 20, Burst psi 35
5) 150” H20, Proof psi 20, Burst psi 35
6) 15” H20, Proof psi 500, Burst psi 1000
7) 30” H20, Proof psi 500, Burst psi 1500
8) 60” H20, Proof psi 500, Burst psi 1500
9) 100” H20, Proof psi 1000, Burst psi 3000
10) 200” H20, Proof psi 1000, Burst psi 3000
11) 400” H20, Proof psi 2400, Burst psi 3000
12) 600” H20, Proof psi 2400, Burst psi 3000
h) As manufactured by:
13) Mercoid.
14) Or approved equal.

2.3 Pressure Switches Low

a) Device identifications: See Section 40 20 00
b) General:
1) Enclosure NEMA 4X
2) Manual Reset trip on increasing pressure
3) DPDT
4) Actuator Seal: Teflon
5) Each pressure switch shall have visible scale and contact operation.
c) Pressure switches shall have a contact rating of 10 amperes at 125 VAC.
d) Pressure switches shall be snap-action switches and shall be in general-purpose enclosures at indoor installations, or weatherproof enclosures at outdoor installations.
e) Diaphragm seals shall be provided and included at the locations shown.

f) Automatic reset.
i) As manufactured by:
1) Mercoid.
2) Or approved equal.

B. The CONTRACTOR shall deliver to the OWNER all required spare parts. The spare parts shall not be used as replacement parts during system start-up or the guarantee period.

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. See Section 40 20 00.

END OF SECTION

SECTION 40 71 00
CONTROL SYSTEMS – PANELS, ENCLOSURES AND COMPONENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes requirements for:

1. Design, fabrication and assembly requirements for all instrumentation enclosures, control panels and components provided under this contract, including but not limited to:
   a. Custom built instrumentation and control panels, including PCMs, RTUs, LCPs, Instrument Junction boxes (IJBs) and power junction boxes (PJBs) etc.
   b. Control panels furnished as part of equipment systems specified in other Divisions, such as vendor control panels (VCP) and chemical feed panels.
   c. Control components.
   d. Control panel fabrication and installation.

B. Related Sections:

1. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Subcontractors to review all sections to ensure a complete and coordinated project.

1.2 REFERENCES

A. Specific References:

1. National Electrical Code (NEC): NFPA 70.
2. National Electrical Manufacturer's Association (NEMA):
   a. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. NEMA ICS 6 - Enclosures for Industrial Control and Systems.
3. Underwriters Laboratories Inc. (UL):
   a. UL 50 - Enclosures for Electrical Equipment.
   b. UL 508 - Industrial Control Equipment.
   c. UL 508A - Standard for Industrial Control Panels.

1.3 DEFINITIONS

A. Specific Definitions:

1. The term “panel” in this Section is interchangeable with the term “enclosure.”

1.4 SYSTEM DESCRIPTION

A. Provide enclosures suitable for the location and environmental conditions in which they are located, unless otherwise indicated.

B. Panel Dimensions:

1. Minimum dimensions are scalable from or as indicated on the Drawings and are based upon manufacturer's non-certified information. It is the responsibility of the Contractor or Manufacturer to design and size all panels:
   a. Size panels to provide space for all equipment, wiring, terminations, and other items in the panel, including space for future build out.
   b. Panel sizes that substantially deviate (± 3 inches in any dimension) from the sizes shown on the Drawings must be approved by the ENGINEER.
   c. Maximum panel depth: 30 inches, unless otherwise indicated.

C. Structural Design:

1. Completed and installed panel work shall safely withstand seismic requirements specified in Section 26 05 00. Enclosures and internal equipment shall be braced to prevent damage from specified forces.

1.5 SUBMITTALS

A. Provide submittals in accordance with Sections 40 10 00 and 40 20 00.
B. Provide a two-phase control panel hardware submittal, for each control panel and enclosure being provided on this project, including but not limited to:

1. Product Data:
   a. Enclosure construction details and NEMA type.
   b. Manufacturer's literature and specification data sheets for each type of basic material to be installed within or on the panel or enclosure.
2. Shop Drawings:
   a. Scaled, detailed exterior panel (front and side views) and interior panel layout showing equipment arrangement and dimensional information:
      1) Provide draft for review and approval of ENGINEER. The ENGINEER has the authority to substantially alter initial panel layouts.
   b. Complete nameplate engraving schedule.
   c. Structural details of fabricated panels.
3. Calculations – Seismic considerations
   a. Provide installation details based on calculated shear and tension forces:
      1) Calculations shall be signed and sealed by a Professional Engineer licensed in the state where the cabinets and panels will be installed.
   b. For assembled enclosures and other equipment with a weight of 200 pounds or more, provide calculations for:
      1) Weight including panel internal components.
      2) Seismic forces and overturning moments.
      3) Shear and tension forces in connections.
4. Calculations – Heat Release
   a. Cooling Calculations, to include but not limited to:
      1) Highest expected ambient temperature for the enclosure's location
      2) Internal heat load:
      3) Exposure to direct sunlight.
      4) Dimensions of the enclosure in inches.

5) Maximum desired temperature inside the enclosure.

C. Phase I shall be the Control Panel Hardware submittal which shall include but not be limited to:

1. Enclosure construction details and NEMA type.
2. Finish, including color chart for ENGINEER selection of color.
3. Layout.
4. Power circuits.
5. Signal and safety grounding circuits.
6. Fuses.
7. Circuit breakers.
8. Signal circuits.
9. Internally mounted instrumentation.
10. Face plate mounted instrumentation components.
11. Internal panel arrangements.
12. External panel arrangements.
13. Construction drawings drawn to scale which define and quantity.
14. The type and gage of fabrication steel to be used for panel fabrication.
15. The ASTM grade to be used for structural shapes and straps.
16. Panel door locks and hinge mechanisms.
17. Type bolts and bolt locations for section joining and anchoring.
18. Details on the utilization of “UNISTRUT” and proposed locations.
19. Stiffener materials and locations.
20. Electrical terminal box and outlet locations.
21. Electrical access locations.
22. Print pocket locations.
23. Writing board locations.
24. Lifting lug material and locations.
25. Physical arrangement drawing drawn to scale which define and quantity the physical groupings comprising:
26. Control panel sections.
27. Auxiliary panels.
28. Subpanels.
29. Racks.
30. Cutout locations with nameplate identifications shall be provided.
31. A bill of material which enumerates all devices associated with the control panel.

D. Phase II shall be the Control Panel Wiring Diagram submittal which shall include but not be limited to:

1. Schematic/Elementary diagrams shall depict all control devices and circuits and their functions.
2. Wiring/Connection diagrams shall locate and identify:
3. Electrical devices.
4. Terminals.
5. Interconnecting wiring.
6. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.

7. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment.
8. These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.
9. Control sequence diagrams shall be submitted to portray the contact positions or connections required to be made for each successive step of the control action.

E. Testing plans, forms, procedures, and other testing submittals.

1.6 QUALITY ASSURANCE

A. Assemble panels, enclosures, and rack systems along with all internal and external devices, wiring, equipment, and materials in a facility that is recognized by Underwriters Laboratories to assemble and certify UL-labeled control panels:

1. Provide all components and equipment with UL508 listing.
2. All control panels shall be UL 508A labeled, unless the equipment in the panel and the design in the contract documents cannot be reasonably modified to meet the requirements for UL508A labeling.

1.7 DELIVERY, STORAGE AND HANDLING

A. Crate all panels for shipment using a heavy framework and skids:

1. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit.
2. Provide suitable shipping stops and cushioning material for all instruments shipped with the panel to prevent damage due to mechanical shock during shipment.
3. Provide each separate panel unit with removable lifting lugs to facilitate handling.

B. Ship all panels by dedicated air ride van, unless otherwise specified or approved.

1.8 PROJECT OR SITE CONDITIONS

A. Environmental Suitability:

1. Provide all control panels and instrument enclosures that are suitable for operation in the site conditions associated with the locations designated in the Contract Documents or as indicated on the Drawings including, but not limited to, material compatibility, site altitude, site seismic, ambient temperature, and humidity conditions.
2. Intrinsically safe.

1.9 SEQUENCING

A. Sequence and schedule in accordance with Section 26 05 00 and accepted progress schedule submitted in accordance with Section 01 31 00.

1.10 WARRANTY

A. Refer to Section 26 05 00.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. As listed below in the individual component paragraphs.
B. Provide instruments and other components performing similar functions of the same type, model, or class, and from one Manufacturer.

2.2 MATERIALS

A. Construct and finish enclosures using materials capable of withstanding the mechanical, electrical, and thermal stresses, as well as the effects of humidity and corrosion that are likely to be encountered in normal service:

1. Enclosures shall have the following properties:
   a. NEMA 1: Steel.
   b. NEMA 4: With gasketed door, rain-tight.
      1) Outdoor: Stainless steel.
      2) Indoor: Stainless steel.
   c. NEMA 4X: With gasketed door, rain-tight.
      3) Outdoor: Stainless steel.
      4) Indoor: Stainless steel.
   d. NEMA 12: Polycarbonate or fiberglass reinforced polyester (FRP) with gasketed door, dust-tight.
   e. NEMA 7: Cast aluminum.

B. Bolting Material:

1. Commercial quality 1/2-inch diameter, plated carbon steel hex-head grade 5 bolts, nuts and washers, with unified coarse (UNC) threads.
2. Carriage bolts shall be used for attaching end plates.
3. All other bolted joints shall have S.A.E. standard lock washers.

2.3 MANUFACTURED UNITS

A. Panels/Enclosures:

1. Manufacturers:
   a. One of the following:
      1) Rittal.
      2) Hoffman Engineering.
      3) Saginaw Control & Engineering.
2. Panel assembly:
   a. General guidelines for panel fabrication include:

1) Continuous welds ground smooth.
2) Exposed surfaces free of burrs and sharp edges.
3) Base formed of heavy channel iron, either galvanized or powder coated, minimum 1/2 inch holes at 12 inch spacing to accommodate anchoring of freestanding enclosures to floor.

b. Construct enclosure and mounting panel using stretcher level sheet metal having minimum thickness not less than the following sizes (U.S. Standard Gauge):

Enclosure Height (inches)	Minimum Enclosure Steel Thickness (gauge)	Minimum Back Mounting Panel Thickness (gauge)
Up to 57	12	12
57 - 69	12	10
69 - 82	12, except 10 on back	10
82 or more	10	10

1) Use heavier sheet metal to meet seismic requirements specified in Section 26 05 00 or, when required due to equipment requirements.

c. Construct supporting frame structure with angled, channeled, or folded rigid section of sheet metal, rigidly attached to and having essentially the same outer dimensions as the enclosure surface and having sufficient tensional rigidity to resist the bending moments applied via the enclosure surface when it is deflected.

d. Provide stiffeners for back mounting panels in enclosures larger than 4 feet. In addition, secure the panels in place by collar studs welded to the enclosure.

e. Doors construction:
1) Turned-back edges suitably braced and supported to maintain alignment and rigidity without sagging.
2) Sufficient width to permit door opening without interference with rear projection of flush mounted instruments.
3) Heavy gauge, piano type, continuous stainless steel hinges.
4) Oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.
5) Gasket installed to seal against roll lip on the enclosure opening.

f. Latches:
1) For panels, other than large types NEMA 4 and 4X, each door provided with a 3-point latching mechanism and padlocking handle with rollers on the ends of the latch rods. Latch rods connected to a common door handle, hold doors securely, forming a compressed seal between door and gasket, at the top, side, and bottom.
2) Include an oil-tight key-locking, 3-point latching mechanism on each door:
a) Provide 2 keys per panel.
b) All locks keyed the same.
3) For large type NEMA 4 and NEMA 4X cabinets, not available with 3-point latching hardware, provide multiple clips and padlock hasps.

g. Panel cut-outs:
1) Cut, punch, or drill cut-outs for instruments, devices, and windows. Smoothly finish with rounded edges.
2) Allow a minimum of 3 inch envelope around all devices.
3) Reinforce around cut-outs with steel angles or flat bars for the following:

a) Large panel cutouts; for example, openings for local operator interfaces.
b) Pilot device groupings, where the removed metal exceeds 50 percent of the available metal.

3. In addition to the requirements specified above, the following requirements for NEMA 4X stainless steel enclosures apply:
   a. Minimum 14 gauge stainless steel.
   b. Captive stainless steel cover screws threaded into sealed wells.
   c. Finish: Unpainted, brushed finish.
   d. Specifically designed for use with flange-mounted disconnect handles where required or as indicated on the Drawings.
4. In addition to the requirements specified above the following requirements for NEMA 4X non-metallic enclosures apply:
   a. Fiberglass construction.
   b. 10-gauge plate steel reinforcing on the sides, top, and bottom.
   c. All seams sealed.
   d. Fiberglass hinges with no exposed metal parts.
   e. Captivate stainless steel door screws.
   f. Provisions for internal, sidewall, mounting panels either by welded channels to the interior, or by welded collar studs.
   g. Provide aluminum mounting panels.
   h. Non-metallic enclosures are not an acceptable substitute for stainless steel unless indicated on the Drawings.
5. Outdoor Panels. Supplementary requirements for panels located outdoors are as follows:
   a. All enclosures located outdoors shall be explicitly designed and rated for outdoor service by the manufacturer.
   b. Finish: Other than stainless steel and fiberglass, the finish shall be outdoor-rated, baked powder coated over dip-coated primer.
   c. Door hardware: stainless steel.
   d. Bases: Heavy channel, gasketed iron bases, flanges up, for anchoring to pad.
   e. Provide rain canopy and sun shield.
6. Arrangement of Components:
   a. Arrange panel internal components for external conduit and piping to enter into panel either from above or below.
   b. Arrange panel instruments and control devices in a logical configuration associating pushbutton and selector switches with related readout devices, or as indicated on the Drawings.
   c. Mount internal control components on an internal back-panel. Devices may be mounted on the side-panel only by special permission from the ENGINEER.
   d. Group cables, and firmly support wiring to the panel. Provide minimum 8 inches clearance between terminal strips or wiring duct and the base of the enclosure for conduit and wiring space.
   e. All control panel mounted operator interface devices shall be mounted between 3 feet and 6 feet above finished floor.
7. Grounding:
   a. Provide the following equipment grounding system:
      1) Equipment grounding conductors and equipment bonding jumpers.
      2) Equipment grounding conductor terminals.
      3) Conductive structural parts of the enclosure.

b. Ensure the continuity of the equipment grounding system by effective connections through conductors or structural members.
c. Size ground wires in accordance with NEC and UL Standards, unless noted otherwise.
d. Provide equipment ground bus with lugs for connection of all equipment grounding wires.
e. Connect all exposed, noncurrent-carrying conductive parts, devices, and equipment shall be connected to the equipment grounding circuit.
f. Provide an equipment grounding terminal for each incoming power circuit, in the vicinity of the phase conductor terminal.
g. Design so that removing a device does not interrupt the continuity of the equipment grounding circuit.
h. Identify equipment grounding conductor terminals with the word "GROUND," the letters "GND" or the letter "G," or the color green.
i. Connect the door stud on the enclosures to an equipment-grounding terminal within the enclosure using an equipment-bonding jumper.
j. Signal (24 VDC) Grounding: Terminate each drain wire of a signal (shielded) cable to a unique grounding terminal block, or common ground bus at the end of the cable as shown on the Loop Drawings.
    1) Bond multi-section panels together with an equipment grounding conductor or an equivalent grounding bus sized in accordance with NEC Table 250.122.
    2) Bond together all PLC or RTU racks (remote or local) processor racks, and conductive enclosures of power supplies and connect to the equipment grounding circuit.

8. Protection:
    1) Provide disconnecting, short-circuit, and overcurrent protection for all control panels.
    2) Select and apply protective devices with proper consideration given, but not limited to the following:
        a) System maximum available fault current at the point of application.
        b) Interrupting rating of the protective device.
        c) Voltage rating of the system.
        d) Load and circuit characteristics:
            1. Normal operating current.
            2. Inrush characteristics.
            3. Thermal withstand capability (I2t).
            4. Magnetic withstand capability (Ip).
        e) Current-limiting ability of the protective device.
        f) Coordination of the protective devices to each other.
    3) Provide a separate protective device for each 120 VAC powered electrical device.
    4) Each 120 VAC Control Loop and Instrument shall have an individual circuit breaker within its respective control panel and clearly identified for function.
    5) Each 120 VAC and 24 VDC PLC output shall have its own individual fuse external of the I/O card with blown fused indication:
        a) Size external fuse to open before any I/O card mounted fuses.
    6) Provide a protective fuse device for each PLC discrete output coordinated to open before the protective device on the PLC I/O card.
    7) Protective devices shall be located on the back mounting panel and identified by a service nameplate in accordance with the wiring diagrams.

8) Provide dedicated single pole circuit breakers, one for the panel lighting luminaire(s), and one for the panel receptacle(s):
   a) 15 amperes, 120VAC.
9) The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 volts ac with a nominal clamping voltage of 200 volts. Surge protectors shall be a non-faulting and non-interrupting design with a response time of less than 0.5 nanoseconds in normal mode and less than 5 nanoseconds in normal mode Peak surge current capability shall be rated for at least 15,000 amps, line to neutral, line to ground and neutral to ground.
   a) Manufacturer: Control Concepts Model IC + 130/IC + 130WL rated 30 amps, or as directed.

9. Conductors and Cables:
   a. Power and Control Wiring:
      1) Materials: Stranded, soft annealed copper.
      2) Insulation: 600V type MTW.
      3) Minimum Sizes:
         a) Primary power distribution: 12 AWG.
         b) Secondary power distribution: 14 AWG.
         c) Control: 16 AWG.
      4) Color:
         a) AC power (line and load): BLACK.
         b) AC power (neutral): WHITE.
         c) AC control: RED.
         d) DC power and control: BLUE.
         e) Ground: GREEN.
   b. Signal Cables:
      1) Materials: Stranded, soft annealed copper.
      2) Insulation: 600V, PVC outer jacket.
      3) Minimum Size: 16 AWG paired triad.
      4) Overall aluminum shield (tape).
      5) Copper drain wire.
      6) Color:
         a) 2 Conductor:
         b) Positive (+): BLACK.
         c) Negative (-): WHITE, RED.
      7) 3 Conductor:
         a) Positive (+): BLACK.
         b) Negative (-): RED.
         c) Signal: WHITE.
      8) Insulate the foil shielding and exposed drain wire for each signal cable with heat shrink tubing.
10. Conductor Identification:
   c. Identify all conductors and cables with wire markers in accordance with Section 26 05 09
   d. Readily identified without twisting the conductor.
11. General Wiring Requirements:
   e. Wiring Methods: Wiring methods and materials for panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise specified.

f. Install all components in accordance with the manufacturer's instructions included in the listing and labeling.
g. Where the electrical power supply voltage to the control panel is more than 120 VAC, provide the panel with a control power transformer and flange mounted disconnect. The disconnect shall be mechanically interlocked with the control enclosure doors so that no door can be opened unless the power is disconnected. Interlocking shall be reactivated automatically when all the doors are closed.
h. Control panels supplied with 120 VAC:
    1) Provide an internal breaker with the line side terminals covered by a barrier.
    2) Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring that the source be disconnected before opening the door to the enclosure.
    3) Provide a nameplate on the cover of the control panel identifying all sources of power supply and foreign voltages within the control panel.
    4) Provide transformers, protective devices, and power supplies required to convert the supply voltage to the needed utilization voltage.
    5) Provide surge protection device on input supply power.
    6) Provide nonmetallic ducts for routing and organization of conductors and cables:
        a) Size ducts for ultimate build-out of the panel, or for 20 percent spare, whichever is greater.
        b) Provide separate ducts for signal and low voltage wiring from power and 120 VAC control wiring:
            1. 120 VAC: Grey colored ducts.
            2. 24 VDC: White colored ducts.
    7) Cables shall be fastened with cable mounting clamps or with cable ties supported by any of the following methods:
        a) Screw-on cable tie mounts.
        b) Hammer-on cable tie mounting clips.
        c) Fingers of the nonmetallic duct.
    8) The free ends of cable ties shall be cut flush after final adjustment and fastening.
    9) Provide supports at the ends of cables to prevent mechanical stresses at the termination of conductors.
    10) Support panel conductors where necessary to keep them in place.
    11) Wiring to rear terminals on panel-mount instruments shall be run in nonmetallic duct secured to horizontal brackets run adjacent to the instruments.
    12) Conductors and cables shall be run from terminal to terminal without splice or joints. Exceptions:
        a) Factory applied connectors molded onto cables shall be permitted. Such connectors shall not be considered as splices or joints.
    13) The control panel shall be the source of power for all 120 VAC devices interconnected with the control panel including, but not limited to:
        a) Solenoid valves.
        b) Instruments, both mounted in the control panel and remotely connected to the control panel.
i. Thermal Management:
    1) Provide heating, cooling, and dehumidifying devices in order to maintain all instrumentation and control devices to within a range as specified in Section 26 05 00.

2) Air Conditioning:
   a) Cooling:
      1. Provide filtered, fan forced type cooling system for each control cabinet.
      2. Size fans, louvers and filters to maintain a cabinet temperature no more than 10°F above ambient electrical room temperature.
      3. Cooling system includes the following components:
      4. Ventilation fans with louver and filter.
      5. Relief air louvers.
      6. Thermostat.
      7. 5 micron air filters for each opening.
   b) Heating:
      1. Provide all panels located in areas that is not climate controlled with thermostatically controlled strip heaters; except, where all of the following conditions apply:
      2. The panel is not supplied with 120 VAC power.
      3. There are no electronics or moisture-sensitive devices in the enclosure.
      4. The panel is smaller than 38 inches high.

2.4 COMPONENTS

A. Panel Meters:

1. Digital:
   a. Self-contained instruments that display process signals directly in engineering units.
   b. Suitable for panel mounting.
   c. LED display:
      1) 0.56-inch height.
      2) Multi-range capabilities.
      3) Integral provisions for scaling.
      4) Switch programmable decimal points.
      5) NEMA 4/IP65 sealed front metal bezel.
   d. Current and Voltage indicators:
      1) 3 1/2 - digit.
   e. Accuracy:
      1) AC/DC volts: ± (0.1 percent of reading + 2 digit).
      2) DC current:
         a) 4 - 20mA: ± (0.1 percent of reading + 1 digit).
         b) 0 - 10V: ± (0.1 percent of reading + 1 digit).
      3) Ratings, protection, and indication:
         a) Maximum applied voltage: 300 VAC/VDC.
   f. Operating voltage: 120 VAC.
   g. Operating temperature: 0 degrees Celsius to 60 degrees Celsius.
      1) Manufacturer, One of the following
         a) Red Lion.

B. Manual Operator Interface Devices:

1. General:
   a. Provide operator pushbuttons, switches, and pilot lights, from a single manufacturer.

b. Size:
    1) 30.5mm.
c. Lamp Color:
    1) On/Running/Start/Open: Green.
    2) Close/Off/Stop: Red.
    3) Power: White.
    4) Alarm: Red.
    5) Status or Normal Condition: White.
    6) Opened: Amber.
    7) Closed: Blue.
    8) Failure: Red.

2. Indoor and Outdoor Areas:
    a. NEMA type 4/13.
    b. Heavy duty.
    c. Pushbutton:
        1) Contacts rated:
            a) NEMA A600.
        2) Furnish one spare normally open and normally closed contact with each switch.
        3) Provisions for locking in the OFF position where lockout provisions are indicated on the Drawings.
        4) Manufacturer: One of the following:
            a) Allen Bradley Type 800T.
            b) Square D Class 9001 Type K.
            c) General Electric Type CR104P.
            d) IDEC TWTD.
    d. Selector switches:
        1) Contacts rated:
            a) NEMA A600.
            b) Knob type:
        2) Manufacturer: One of the following
            a) Allen Bradley Type 800T.
            b) Square D Class 9001 Type K.
            c) General Electric Type CR104P.
            d) IDEC TWTD.
        3) Furnish one spare normally open contact and normally closed contact with each switch.
        4) Provisions for locking in the OFF position where lockout provisions are indicated on the Drawings.
    e. Pilot lights:
        1) Type:
            a) LED for all interior installations.
            b) Full Voltage for exterior installations.
        2) Push to Test.
        3) LED Lamp.
        4) Manufacturer: One of the following
            a) Allen Bradley Type 800T.
            b) Square D Class 9001 Type K.
            c) General Electric Type CR104P.

d) IDEC TWTD.

C. Relays:

1. General:
   a. For all types of 120 VAC relays, provide transient surge protection across the coil of each relay.
   b. For all types of 24 VDC relays, provide a free-wheeling diode across the coil of each relay.
2. General Purpose:
   a. Magnetic control relays.
   b. NEMA A300 rated:
      1) 300 Volts.
      2) 10 Amps continuous.
      3) 7,200 VA make.
      4) 720 VA break.
   c. Plug-in type.
   d. LED indication for relay energized.
   e. Coil voltages: As indicated on the Drawings.
   f. Minimum poles: 2PDT.
   g. Touch safe design: All connection terminals to be protected against accidental touch.
   h. Enclose each relay in a clear plastic heat and shock-resistant dust cover.
   i. Quantity and type of contact shall be as shown on the Drawings or as needed for system compatibility.
   j. Sockets for relays shall have screw-type terminals.
   k. Provide additional (slave/interposing) relays when the following occurs:
      1) The number or type of contacts shown exceeds the contact capacity of the specified relays.
      2) Higher contact rating is required in order to interface with starter circuits or other equipment.
   l. DIN rail mounting on 35mm rail.
   m. Ice Cube type relays shall be provided with retainer clips to secure relay in socket.
   n. Integrated label holder for device labeling.
   o. Manufacturer: One of the following:
      1) Phoenix Contact PLC series.
      2) Potter and Brumfield Type KRP or KUP.
      3) IDEC R* series. (* = H, J, R, S, U).
      4) Allen Bradley Type 700 H Series.
      5) Square D Type K.
      6) Turck
3. Machine Tool Relays:
   a. Magnetic industrial relays.
   b. NEMA A600 rated:
      1) 600 Volts.
      2) 10 Amps continuous.
      3) 7,200 VA make.
      4) 720 VA break.
   c. Coil voltage: As indicated in the Contract Documents.

d. Convertible contact cartridges to convert any contact from a normally open to a normally closed configuration.
e. Contact cartridges shall have a clear cover for visual inspection.
f. Contact material shall be fine grade silver.
g. Minimum number of poles: 4 Type “A” or Type “B”, or as indicated on the Drawings, plus 1 spare.
h. Machine tool type.
i. Touch safe design: All connection terminals to be protected against accidental touch.
j. Integrated label holder for device labeling.
k. DIN rail mounted on 35mm rail.
l. Manufacturer: One of the following
    1) Allen Bradley type 700P.
    2) Square D type 8501XO.
    3) Cutler Hammer D15 series.

4. Latching:
    a. Magnetic latching control relays.
    b. NEMA B300 rated:
        1) 300 Volts.
        2) 10 Amps continuous.
        3) 3,600 VA make.
        4) 320 VA break.
    c. Plug-in type.
    d. DIN rail mounting on 35mm rail.
    e. Coil voltage: 120 VAC.
    f. Minimum poles: 2PDT; as indicated on the Drawings, plus 1 spare.
    g. Touch safe design: All connection terminals to be protected against accidental touch.
    h. Clear cover for visual inspection.
    i. Provide retainer clip to secure relay in socket.
    j. Manufacturer:
        1) One of the following, or equal:
            a) Square D type 8501 Type K.
            b) IDEC TWTD.
5. Time Delay:
    a. Provide time delay relays to control contact transition time.
    b. NEMA A300 rated:
        1) 300 Volts.
        2) 10 Amps continuous.
        3) 7,200 VA make.
        4) 720 VA break.
    c. Plug-in type.
    d. DIN rail mounting on 35mm rail.
    e. Coil voltage: as indicated in Contract Documents.
    f. Provide Electronic type with on-delay, off-delay, and on/off delay.
    g. Minimum poles: 2PDT; as indicated on the Drawings, plus minimum 1 spare.
    h. Units shall include adjustable dial with graduated scale covering the time range in each case.
    i. Minimum timing range: 0.1 seconds to 10 minutes.
    j. Manufacturer: One of the following:

1) Agastat type Series 7000.
2) Allen Bradley type 700HR.

D. Terminal blocks:

1. Din rail mounting on 35mm rail.
2. Suitable for specified AWG wire.
3. Rated for 30 amperes at 600 Volts.
4. Screw terminal type.
5. Provide mechanism to prevent wire connection from loosening in environments where vibration is present. This mechanism shall not cause permanent deformation to the metal body.
6. Finger safe protection for all terminals for conductors.
7. Construction: Polyamide insulation material capable of withstanding temperature extremes from - 40 degree Celsius to degree 105 Celsius.
8. Terminals: Plainly identified to correspond with markings on the diagrams:
   a. Permanent machine printed terminal identification.
9. Identify terminals suitable for use with more than 1 conductor.
10. Position:
    a. So that the internal and external wiring does not cross.
    b. To provide unobstructed access to the terminals and their conductors.
11. Provide minimum 25 percent spare terminals.
12. Manufacturer: One of the following:
    a. Phoenix Contact UK5 Series.
    b. Entrelec M4/6.
    c. Allen Bradley Series 1492.
13. Wire duct:
    a. Provide flame retardant plastic wiring duct, slotted with dust cover.
    b. Type:
       1) Wide slot.
       2) Narrow slot.
       3) Round hole.
    c. Manufacturer: One of the following:
       1) Panduit.
14. Fuses (holders) and circuit breakers:
    a. Fuse holders:
       1) Modular type:
          a) DIN rail mounting on 35mm rail.
          b) Touch safe design: All connection terminals to be protected against accidental touch.
          c) Incorporates blown fuse indicator.
       2) Provide nameplate identifying each fuse:
          a) In accordance with Section 16075.
       3) Manufacturer: One of the following:
          a) Phoenix Contact.
          b) Entrelec.
          c) Allen Bradley 1492-FB Series B.
15. Control Circuit Breakers:

a. DIN rail mounting on 35mm rail.
b. Manual OPEN-CLOSE Switch.
c. Rated 250 VAC.
d. Interrupt Rating: As indicated on the Drawings.
e. Current ratings: As indicated on the Drawings.
f. Provide nameplate identifying each circuit breaker, refer:
    1) In accordance with Section 16075.
g. Manufacturer: One of the following:
    1) Phoenix Contact.
    2) ABB.
    3) Allen Bradley Series.
    4) Square D.
    5) Entrelec.

E. Transient / Surge Protection Devices:

1. Provide Surge Protection Device (SPD) for Power Entrances:
    a. Nominal 120 VAC with a nominal clamping voltage of 200 Volts.
    b. Non-faulting and non-interrupting design.
    c. A response time of not more than 5 nanoseconds.
2. Control Panel Power System Level Protection, non-UPS powered:
    a. Design to withstand a maximum 10 kA test current of a 8/20µs waveform according to ANSI/IEEE C62.41.1-2002 Category C Area.
    b. Provide both normal mode noise protection (between current carrying conductors) and common mode (between current carrying conductor and neutral) surge protection.
    c. DIN rail mounting.
    d. Attach wiring to the SPD by means of a screw type cable-clamping terminal block:
        1) Gas-tight connections.
        2) The terminal block: Fabricated of non-ferrous, non-corrosive materials.
    e. Visual status indication of MOV status on the input and output circuits.
    f. Dry contact rated for at least 250 VAC, 1 Amp for remote status indication.
    g. Meeting the following requirements:
        1) Response time: ≤ 100 ns.
        2) Attenuation: ≥ - 40dB at 100 kHz as determined by a standard 50 ohms insertion test.
        3) Safety approvals:
            a) UL 1283 (EMI/RFI Filter).
            b) UL 1449 2nd Edition.
    h. Manufacturer: One of the following:
        1) Phoenix Contact type SFP TVSS/Filter.
        2) Liebert Accuvar series.
        3) Islatrol.
3. Data and Signal Line Protectors – Panel Mounted:
    a. Surge protection minimum requirements: Withstand a 10 kA test current of a 8/20µs waveform in accordance with ANSI/IEEE C62.41.1-2002 Category C Area.
    b. DIN rail mounting on 35mm rail (except field mounted SPDs).
    c. SPD's consisting of 2 parts:
        1) A base terminal block.

2) A plug protection module:
   a) Replacing a plug shall not require the removal of any wires nor interrupt the signal.
   b) Base and plug shall have the ability to be coded to accept only the correct voltage plug.

d. SPD Manufacturer: One of the following:
   1) Phoenix Contact Plugtrab Series.
   2) Joslyn JMD Series.

4. Data and Signal Line Protectors – Field Mounted:
   a. Surge protection minimum requirements: Withstand a minimum 10 kA test current of a 8/20µs waveform in accordance with ANSI/IEEE C62.41.1-2002 Category C Area.
   b. Manufacturer: One of the following:
      1) Phoenix Contact type SFP TVSS/Filter.
   c. SPD Manufacturer: One of the following:
      1) Phoenix Contact Pipetrab.
      2) Boxtrab.
      3) Joslyn JMD Series.

F. Power supplies:

1. Design power supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the system operation.
2. Convert 120 VAC to 24 volt DC or other DC voltages required or as indicated on the Drawings.
3. Provide backup 24 VDC power supply units to automatically supply the load upon failure of the primary supply.
4. Provide power supplies configured as fully redundant units consisting of 2 power supplies connected with an automatic switchover unit with alarm contacts monitored by the PLC and alarmed in SCADA.
5. Sized to provide 40 percent excess rated capacity.
6. UL508C listed to allow full rated output without de-rating.
7. Provide fuse or short-circuit protection.
8. Provide a minimum of 1 set of dry contacts configured to change state on failure for monitoring and signaling purposes.
9. Output regulation: ± 0.05 percent for a 10 percent line change or a 50 percent load change:
   a. With remote voltage sensing.
10. Operating temperature range: 0 degrees Celsius to 50 degrees Celsius.
11. Touch safe design: All connection terminals to be protected against accidental touch.
12. DIN rail mounting on 35mm rail.
13. Provide self-protecting power supplies with a means of limiting DC current in case of short circuit.
14. Manufacturer: One of the following:
    a. Phoenix Contact Quint series.
    b. IDEC PS5R series.
    c. Sola.
    d. Acopian.
    e. Puls.

G. Intrinsic Safety Barriers:

1. Transformer isolated barrier:
   a. Containing a transformer to provide complete:
      1) Isolation between the safe and hazardous areas for loop powered devices.
      2) 3-way isolation between the safe area, hazardous area and power supply powered devices.
   b. Resistor for current limitation.
   c. Fuses for short circuit protection.
   d. Provide barriers with pluggable connectors that are coded for easy replacement.
   e. Transmission error shall be less than or equal to 0.1 percent of full scale.
   f. DIN rail mounted on 35mm DIN rail.
   g. Approvals:
      1) FM.
      2) UL 913 & 1604.
2. Types:
   a. Switch Isolators:
      1) Designed and approved for use with discrete inputs.
      2) Supply Power: 20-30VDC.
      3) Output to track input.
      4) With an LED in the cover to indicate the status of the input.
      5) With a selector switch to change the logic of the input.
      6) Input - dry contact.
      7) Output - SPDT relay.
   b. Transmitter and Converters for use with 4-20 mA signals without Hart® communications capability:
      1) Designed and approved for use with 4-20 mA analog signals.
      2) Designed for powering 2 and/or 3 wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
      3) Supply voltage: 20-30VDC.
   c. Transmitter and converters for use with 4-20 mA signals with Hart® communications capability:
      1) Designed and approved for use with 4-20 mA analog signals.
      2) Designed for powering 2 and/or 3 wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
      3) In addition, transfer digital signals from the hazardous area to the safe area.
      4) Complete bi-directional communication between a smart transmitter located in the field and the suitable equipment located in the safe area.
      5) Supply voltage: 20-30VDC.
3. Manufacturer: One of the following:
   a. Phoenix Contact ME Series.
   b. Pepperl + Fuchs.
   c. Turck.

H. Disconnects and starters:

1. Flange Mounted Main Disconnect:

a. Rated 22KAIC or as required by the short circuit and coordination study specified in Section 16305, whichever is larger:
   1) Size in accordance with the NEC, total connected horsepower and associated locked rotor current, and provide larger unit if needed based on any of these criteria.
b. Interlocked with the door of the control panel so that the door of the panel cannot be opened with the disconnect switch in the closed position, with defeater.
c. Door mounted disconnects are not acceptable.
d. Manufacturer: One of the following:
   1) Allen Bradley - 1494.
   2) Cutler Hammer - C361/C371.
   3) ITE - FH011.
   4) Square D - Class 94222.

2. Magnetic Motor Starters:
   a. In conformance with the requirements of Section 16421.
   b. Minimum 22 KAIC or as required by the Short Circuit and Coordination study, which ever is larger.
3. Integral Self-Protected Starters:
   a. In conformance with the requirements of Section 16421.

I. Limit Switches:

1. NEMA-4X.
2. AC contact rating 120V, 10A.
3. DC contact rating 125V, 0.4A.
4. DeviceNet Compatible as indicated in the drawings.
5. Provide robust actuation mechanism not prone to degradation.
6. Provide complete actuator mechanism with all required hardware.
7. Allows for contact opening even during contact weld condition.
8. UL approved.
9. Operating Temperature Range: -18 degrees to +110 degrees Celsius (0 degrees to 230 degrees Fahrenheit).
10. Manufacturer:
    a. Allen Bradley 802.
    b. Honeywell HDLS.
    c. Omron D4.
    d. Eaton E47, E49, E50.
    e. ABB equal.

2.5 ACCESSORIES

A. Provide panels with an inside protective pocket to hold the panel Drawings. Ship panels with 1 copy of accepted Shop Drawings including, but not limited to, schematic diagram, connection diagram, and layout drawing of control wiring and components in a sealed plastic bag stored in the panel drawing pocket.
B. Tag or identifying number of the panel as indicated on the Drawings.

1. Provide in accordance with Section 16075 on all internal and external instruments and devices.

2. Provide a nameplate with the following markings that is plainly visible after installation:
   a. Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the panel can be identified.
   b. Supply voltage, phase, frequency, and full-load current.
   c. Short-circuit current rating of the panel based on one of the following:
      1) Short-circuit current rating of a listed and labeled assembly.
      2) Short-circuit current rating established utilizing an approved method.

2.6 FINISHES

A. Finishes:

1. Metal surfaces of panels shall be prepared by chemical cleaning and mechanical abrasion in accordance with the finish manufacturer's recommendations to achieve a smooth, well-finished surface.
2. Scratches or blemishes shall be filled before finishing. One coat of zinc phosphate shall be applied per the manufacturer's recommended dry film thickness, and allowed to dry before applying the finish coat.
3. Finish coat shall be a baked polyester urethane powder, aliphatic air-dry polyurethane, or epoxy enamel to meet NEMA rating specified application.
4. Exterior of enclosures located outdoors shall be UV resistant polyester powder coating. Total dry film thickness shall be 3 mils, minimum.

B. Colors:

1. Exterior color of panels mounted indoors shall be manufacturer's standard light gray.
2. Exterior of panels mounted outdoors shall be manufacturer's standard white.
3. Panel interiors shall be manufacturer's standard white.

2.7 SOURCE QUALITY CONTROL

A. Refer to Section 01 55 00.

PART 3 EXECUTION

3.1 EXAMINATION

A. Refer to Section 26 05 00.

3.2 INSTALLATION

A. Any components or panels damaged during installation shall be replaced.
B. Install enclosures so that their surfaces are plumb and level within ± 1/8 inch over the entire surface of the panel; anchor securely to wall and structural supports at each corner, minimum. Direct attachment to dry wall is not permitted.
C. Install the enclosure per guidelines and submitted installation instructions to meet the seismic requirements at the project site.
D. Provide floor stand kits for wall-mount enclosures larger than 48 inches high.

E. Provide 3-1/2 inch high concrete housekeeping pads for free-standing enclosures.
F. Install gasket and sealing material under panels with floor slab cutouts for conduit:

    1. Undercoat floor mounted panels.

G. Provide a full size equipment-grounding conductor in accordance with NEC included with the power feeder. Terminate to the incoming power circuit-grounding terminal.
H. All holes for field conduits, etc. shall be cut in the field, there shall be no additional holes, factory cut holes, or hole closers allowed. Incorrect holes, additional holes, or miss-cut holes shall require that the entire enclosure be replaced.
I. Control panels that are adjacent to motor control centers shall be fully wired to the motor control centers using wireways integral to the motor control center or additional conduits as needed. These interconnections are not shown or reflected on the conduit schedule, but shall be shown on the Loop Drawings prepared by the CONTRACTOR.

3.3 FIELD QUALITY CONTROL

A. Refer to Section 26 05 00.

3.4 CLEANING

A. Clean area during construction in accordance with Section 01 50 00.

3.5 PROTECTION

A. Refer to Section 26 05 00.

- END OF SECTION -

THIS PAGE INTENTIONALLY LEFT BLANK

December 11, 2024

SECTION 40 91 13
GAS MONITORS

PART 1 - GENERAL

1.1 MANUFACTURED UNITS

A. Gas Detection must detect but is not limited to detection of Chlorine Gas.

1. Device identifications: See Section 17200.
2. General

    a. Measuring Ranges and Resolution:
    0-50 ppm max range CL2 1% LEL resolution
    b. Accuracy:
    <±3%
    c. Repeatability:
    <5% of signal
    d. Long Term Drift:
    <0.05% of signal/month
    e. Response time to Alarm:
    ALARM: <10 seconds
    WARNING: <30 seconds
    f. Temperature and Humidity:
    Temperature -18°C ~ 40°C
    (Intermittent Operation) -23°C ~ 49°C
    Humidity 0% - 90% non-condensing
    g. Power Supply (input voltage and current):
    24 VDC (12-28 VDC), 150 mA (nominal)
    h. Analog Signal - Include the 4-20 mA Output Signal option:

3-wire interface
1000 ohms max @ 24 VDC, 500 ohms @ 12VDC
User programmable scaling

i. Alarms:
User programmable low and high alarms, fault
Display indication for alarms

j. Relays:
Three SPST, normally open relays
Contact Capacity: 5 A at 120/250 VAC or 30 VDC
Calibration Interface:

k. Enclosure (main electronics unit):
Material: NEMA 4X

l. Sensor Housing Material:
Appropriate for CL2 Gas, NEMA 4X

3. The monitor shall be:

   a. ACCUTEC 35 or approved equal.

END OF SECTION

December 11, 2024

SECTION 40 91 20
PRESSURE GAUGES

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install, and place into satisfactory operation the pressure gauges and seals with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED SPECIFICATION SECTIONS

A. Section 40 20 00 – Instruments, General

B. Section 40 27 60 – Pressure Seals

1.3 SUBMITTALS

A. Furnish complete submittals in accordance with Section 01 30 00.

B. Product Data

1. Complete manufacturer's brochures; identify instrument construction, accuracy, ranges, materials and options.

2. Complete instrument data sheets, including catalog number and source for determining catalog number for all gauges and seals.

PART 1 - PRODUCTS

2.1 PRESSURE INSTRUMENTATION

A. Seals

1. All pressure gauges shall be provided with seals. See Section 40 27 60.

2. Pressure gauges and seals shall be assembled and oil filled at the factory prior to shipment. Filling fluid shall be compatible with piping contents and temperature.

2.2 PRESSURE GAUGES MANUFACTURED UNITS

A. Pressure, Vacuum, Compound Gauges.

1. General

a. Furnish and install pressure and vacuum gauges as specified; complete, including all fittings, snubbers, connections, gaskets, supports and accessories in the locations shown or specified, in accordance with the Contract Documents.

b. Pressure gauges shall be provided whether or not shown on the plans:

1) On discharge connection to all pumps. Pressure range as indicated on plans.

2) On discharge connection from blowers and compressors.

3) On each side of pressure reducing valves.

4) In other locations as shown on the P&IDs and/or mechanical plans.

c. Vacuum gauges shall be provided whether or not shown on the plans:

1) On all supply side educator type chemical feeders.

2) In other locations as shown on the P&IDs and/or mechanical plans.

d. Sleeve pressure gauges

1) Shall be provided where shown on the plans.

2) Pressure shall be sensed by a flexible sleeve contained in a flanged cast iron or steel spool or wafer body, and transmitted to the gauge through a captive fluid.

3) Sleeve shall be of BUNA A and fabricated so as to isolate the body from the process liquid.

4) Gauges shall be calibrated to read in applicable units.

5) Accuracy of ±1% to 150% of the working pressure of the system to which they are connected.

e. Compound pressure gauges shall be provided whether or not shown on the plans:

1) On suction connection to all pumps. Pressure range as indicated on plans.

2. Construction

a. Gauges shall be industrial quality type with Type 316 stainless steel movement.

b. Phenolic case.

c. Liquid filled.

d. Unless otherwise shown or specified, gauges shall have:

1) A 4 ½ inch dial.

2) ½ inch threaded connection.

3) Type pulsation dampener adapter.

a) Pulsation Dampener as manufactured by:

b) Cajon Co.

c) Weksler Instruments, Corp.

d) Ashcroft.

e) No equals.

4) A block and bleed valve – ½ inch national pipe thread process connection and bleed/calibrate valve between block valve and outlet port.

e. Gauges shall be calibrated to read in applicable engineering units.

f. Accuracy of ±0.5% to 150% of the working pressure or vacuum of the pipe or vessel to which they are connected.

g. All gauges shall be vibration and shock resistant.

3. Seals

a. Gauges attached to systems without particulates shall be equipped with seals. See Section 40 27 60.

4. Gauges general as manufactured by:

a. Ashcroft Industrial Instruments (Dresser). With Plus Performance.

b. Forboro/Jordan, Inc. Equivalent model

5. Gauges sleeve pressure as manufactured by:

a. Red Valve Co., Inc.

b. Ronningen-Petter.

c. Onyx.

d. No Equal.

6. Snubbers as manufactured byL

a. Cajon Co.

b. Weksler Instruments, Corp.

c. Ashcroft.

d. No Equal.

7. Pulsation dampeners as manufactured by:

a. Cajon Co.

b. Weksler Instruments, Corp.

c. Ashcroft.

d. No Equal.

2.3 ACCESSORIES

A. Gauges shall be liquid filled or have some equivalent technology.

2.4 SOURCE QUALITY CONTROL

A. All instruments and/or representative instruments shall be calibrated to in facilities and with instruments traceable to the National Bureau of Standards.

1. Provide complete documentation covering the traceability of all calibration instruments.

PART 2 - EXECUTION

3.1 EXAMINATION

A. Examine the complete set of plans, the process fluids, pressures and temperatures and furnish instruments that are compatible with installed process condition.

3.2 PREPARATION

A. Coordinate the installation with all trades to ensure the mechanical system has all necessary appurtenances, weldolets, valves, orientation, etc. for proper installation of the instruments.

3.3 INSTALLATION

A. All instruments shall be installed in strict conformance with the manufacturer's recommendations.

1. It is the CONTRACTOR's responsibility to install all instruments in conformance with manufacturer's recommendations.
2. It is the CONTRACTOR's responsibility to notify the ENGINEER of any installation conditions that may be shown at variance with the manufacturer's recommendations.
3. Install two 2 –valve instrument manifolds for each gauge pressure transmitter.
4. Bolt 3 valve manifolds at non-flange diaphragm type differential pressure transmitters in place of standard flange adapters.
5. Install root valves at process taps except insertion elements.
6. Install gauge valves on process connections to instruments where multiple instruments are connected to one tap or where root valves are not readily accessible.
7. All gauges shall be installed with the face in the vertical position.
8. In strict accordance with the manufacturer's printed instructions.
9. At the locations shown on the drawings, when so shown.
10. Care shall be taken to minimize the effect of water hammer or vibrations on the gauges.
11. In extreme cases, and with the approval of the ENGINEER, gauges may be mounted independently, with flexible connectors.

3.4 FIELD QUALITY CONTROL

A. The Instrumentation and Control Systems Contractor shall calibrate all instruments in the field during the Calibration and Loop Validation Tests as identified in Section 40 10 00.

3.5 ADJUSTING

A. All instruments shall be field verified.

3.6 DEMONSTRATION

A. Performance of all instruments shall be demonstrated to the ENGINEER prior to commissioning.

3.7 PROTECTION

A. All instruments shall be fully protected after installation and before commissioning.

The CONTRACTOR shall replace any instruments damaged prior to commissioning.

1. The ENGINEER shall be the sole party responsible for determining the corrective measures.

3.8 SCHEDULES

A. The following instrument data sheets are included as a guideline for the supply of the instruments. These sheets are not complete and the instrument selection shall be the CONTRACTOR's responsibility. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review. The CONTRACTOR shall provide documented evidence for a differential, plus or minus, that results from these changes.

B. The CONTRACTOR shall supply complete instrument data sheets for each and every instrument and submit this information.

1. Instrument data sheets shall be furnished in both hard copy and electronic format.

END OF SECTION

December 11, 2024

SECTION 40 91 21
TEMPERATURE TRANSMITTER

PART 1 - GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall furnish, test, install, and place into satisfactory operation the pressure transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 40 10 00 – Process Control and Information Systems
B. Section 40 20 00 – Instruments, General

PART 2 - PRODUCTS

2.1 TEMPERATURE TRANSMITTERS

A. Room Temperature Transmitters
   1. Pressure transmitter shall be 24-28 VDC powered from PLC panel power supply, Foxboro I/A Series, or equal. Power supply shall be VDC powered from PLC panel power supply. Transmitter shall be wall mounted with bare transducer element below sensing room temperature. Signal output shall be 4 to 20 mA.
   2. Temperature transducer shall be RTD type. Element shall be bare connected directly to transmitter. Adjustable dampening shall be provided. External zero adjustment shall be provided. Accuracy shall be +/- 0.0 degrees Fahrenheit.

B. Water Temperature Transmitters
   1. Pressure transmitter shall be 24-28 VDC powered from PLC panel power supply, Foxboro I/A Series or equal. Signal output shall be 4 to 20mA. Transmitter shall be wall mounted with conduit for RTD cable.
   2. Temperature transducer shall be RTD type. Element shall be submersible and connect to submersible RTD cabling with submersible connection. Adjustable dampening shall be provided. External zero adjustment shall be provided. Accuracy shall be +/- 0.1 degrees Fahrenheit.

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. Refer to Section 40 20 00.

END OF SECTION

SECTION 46 31 11
CHLORINATION EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. This section addresses the work necessary to install an operating and tested manually adjusted flow rate gas chlorination system. Contractor shall supply and install all equipment defined herein and shall provide all other components required for a complete and functional system.

1.2 REFERENCES AND STANDARDS

A. Work under this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME).

1. B 16.3 Malleable Iron Threaded Fittings, Classes 150 and 300

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. A 53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
2. B 88 Seamless Copper Water Tube
3. D 1784 Rigid Polyvinyl Chloride (PVC) Compounds and /Chlorinated Polyvinyl Chloride (CPVC) Compounds
4. D 1785 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
5. D 1998 Standard Specifications for Upright Storage Tanks
6. D 2466 Polyvinyl Chloride (PVC) Plastic Pipe and Fittings, Schedule 40
7. D 2564 Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
8. F 411 Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe, Schedules 40 and 80

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. C800 Standard for Underground Service Line Valves and Fittings
2. C900 Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. – 60 In. (100mm – 1500 mm)
3. C901 Polyethylene (PE) Pressure Pipe and Tubing 1/2 In. (13mm) – 3 In. (76 mm), for Water Service

E. CHLORINE INSTITUTE (CI)

1. CI-01 The Chlorine Manual
2. CI Pamphlet 6 – Piping Systems for Dry Chlorine
3. CI Pamphlet 155 – Water and Wastewater Operators Chlorine Handbook

F. INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

G. INTERNATIONAL MECHANICAL CODE (IMC)

H. INTERNATIONAL PLUMBING CODE (IPC)

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Submit operation and maintenance manuals and installation instructions for all chlorination equipment.

1.4 WARRANTY

A. Manufacturer shall provide to Engineer written guarantee against defects in material or workmanship for a period of one (1) year from the date of substantial completion for all equipment utilized.

1.5 DELIVERY AND STORAGE

A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, and dust, or other contaminants.

PART 2 PRODUCTS

2.1 GAS CHLORINATION SYSTEM

A. Equipment (piping, injector and ejector must be rated for a minimum of 150 psi working pressure)

1. Flow vacuum regulators with automatic switchover capability
2. Stainless steel shelf with Hach 225401 chlorine drop test kit
3. 5”, 20 pound/day rotameter
4. Manual flow proportioning valve
5. Chlorine ejector
6. Chlorine injector
7. Vacuum gauge 0-30 in. Hg complete with diaphragm seal and isolation valve to connect to the chlorine gas under vacuum line
8. Miscellaneous vacuum and vent tubing with fittings, accessories
9. Dual cylinder scales and safety chains
10. Electronic scale indicator
11. Allegro respirator wall storage case
12. Large MSA Chin-type advantage 3100 gas mask and two chlorine cartridges

B. The Contractor shall install a vacuum operated solution feed and manually adjustable chlorination system at well site as shown on the Drawings. The system will utilize 150-pound cylinders.

C. The automatic switchover chlorinators shall be vacuum operated solution feed and shall automatically switch the chlorine supply from an empty cylinder to a full cylinder. The system shall have automatic reset and shall not permit return to the initial source until the second source is empty.

D. The chlorinator shall have a maximum capacity of 20 pounds of chlorine feed per day.

E. Each system shall consist of the following: Two (2) vacuum regulators with automatic switchover valves, two (2) 5" gas flow rotameters with rate valves, two (2) manual gas flow valve, two (2) ejector/diffuser assemblies, two (2) injectors, and two (2) dual chlorine scale. Other equipment required:

1. Standard equipment furnished with the chlorinator including strainer, spare parts, lead gaskets, clamps, multi-purpose wrench and adapters.

F. Contractor shall furnish chlorine needed for testing and adjustment of the equipment.

G. The equipment and piping layout indicated on the Plans shall be taken in a sense as diagrammatic. The alignment of piping and the arrangement of equipment shall be varied from that indicated on the Plans to suit the equipment furnished, without additional cost. The Contractor shall submit to the Engineer complete detailed drawings of the proposed installation, following the manufacturer's recommendations, in adequate time for proper sleeving and conduit work involved with the building structure.

2.2 VACUUM REGULATORS AND AUTOMATIC SWITCHOVER VALVES

A. Vacuum regulators shall be rated for 20 ppd with integral switchover valve modules.

2.3 ROTAMETERS

A. Rotameters shall be Wallace & Tiernan S10K V-Notch 5" rotameter rated for 20 ppd, or pre-approved equal.

2.4 FLOW VALVE

A. Each flow proportional valve flow rate shall be manually adjustable. The valve shall operate on 115/230 VAC single phase power. The valve shall include a 5" rotameter and be able to operate from 32°F to 120°F with a calibration accuracy of ±0.25% from zero.

2.5 EJECTOR ASSEMBLY

A. Ejectors shall be 20 ppd diaphragmless high pressure type rated for 150 psi working pressure with built in check valve. They shall be manufactured from high impact plastic. They shall be Wallace & Tiernan or pre-approved equal.

2.6 INJECTION QUILL ASSEMBLY

A. The Corp Stop shall be 3/4-inch with a PVC quill that extends into the pipe by one third the diameter.

B. Injection Quill Assembly shall be a SAF-T-FLO Chemical Injection Assembly or approved equal.

C. The anti-siphon valve shall be Wallace & Tiernan, or pre-approved equal with a 0-150 psi rating.

2.7 CYLINDER SCALES

A. Scales shall be capable of holding 150 lb cylinders. Platforms shall be corrosion resistant and have a low profile. Each platform shall include an electronic stainless steel load cell with an output of a 4-20 mA signal. Scales shall include a chaining brackets. Scales shall be Justrite steel gas cylinder stand, 2 cylinder capacity model 35288 or pre-approved equal.

B. Electronic scale indicator shall be capable of monitoring two scales. The indicator shall be Force Flow Solo G2 SRG2-2 or pre-approved equal.

2.8 CHLORINE BOOSTER PUMP AND MOTOR

A. Provide and install chlorine booster pump (see Spec 33 12 20 Water Utility Distribution Pumps) with NPT inlet/outlet to provide source water to the ejector assembly
B. Booster pump shall be mounted on a concrete pedestal per plans.

2.9 WATER SUPPLY LINE

A. The Contractor shall furnish and install the water supply lines as shown on the drawings including all valves, pipe, tubing, corp stops, couplings, strainers, and any other accessories necessary to have a complete and operational system. PE pipe shall be DR 7.3 IPS. PVC pipe shall be Schedule 80.

2.10 BALL VALVES

A. PVC ball valves for the chlorination solution piping shall be Spears Industrial Grade Sealed Unit with PTFE ball seats, EPDM o-rings, and high impact handle. Valves shall be full port rated for water to 235 psi.

2.11 PIPING AND TUBING

A. Piping and tubing shall be suitable to handle the materials carried as recommended by the manufacturer.

B. Piping and fittings shall be PE, PVC or as otherwise noted in the specifications or on the drawings. PVC pipe shall be Schedule 80.

2.12 SAFETY EQUIPMENT

A. Cylinder restraint systems.

B. A bottle of ammonium hydroxide, 56% ammonia solution for chlorine leak detection.

C. An 18 Guage 2'x6" stainless steel shelf shall be provided above the chlorine regulator.

D. Respirators: Provide Allegro respirator wall storage case and Large MSA Chin-type Advantage 3100 gas mask with two chlorine cartridges respirators. Respirators shall meet the National Institute for Occupational Safety and Health for 150 pound chlorine cylinder applications.

2.13 HAZARDOUS MATERIAL IDENTIFICATION SIGNS

A. Contractor shall furnish hazardous material identification signs. Sign dimensions shall be 7" x 10". Signs shall be Northern #231-29843, #231-30333, #231-29870, and #231-29871, Accu-Shield construction.

2.14 VENTS

A. Tubing vents shall extend to the outside of structures and be turned down and be equipped with a #14 mesh non-corrodible screen.

B. Intake vents shall be motor operated and have #14 mesh screens.

2.15 MULTI-POINT CHLORINE GAS DETECTION SYSTEM

A. A multi-point gas detector shall be supplied for monitoring the concentration of chlorine in the facility. The system shall consist of a NEMA 4X alarm module and a remote mounted gas sensor/transmitter for chlorine gas. A sensor/transmitter shall provide the gas measurement function for the system. The sensor/transmitters shall consist of a stable electrochemical gas sensor that shall generate a signal linearly proportional to gas concentration. The entire assembly shall be coated to minimize RFI interference. Each sensor/transmitter shall be supplied with an electrochemical gas generator closely coupled to the sensor which shall automatically generate a small concentration of gas every 24 hours to verify sensor operation. During the verification test, alarm relays shall be inhibited. A battery backup module shall be supplied to provide standby power to

the gas detector. The battery backup module shall be housed in a NEMA 4X enclosure and shall be suitable for operating the detector for at least 4 hours.

B. Two programmable alarm set points shall be provided for warning personnel of differing levels of leakage. Gas leak alarms shall be indicated by flashing LED indicators on the alarm receiver and activation of the SCADA system. The concentration of the gas shall be displayed directly in PPM units. Three alarm relays shall be provided for external alarming functions. Each alarm relay shall be independently assignable to either the low or the high alarm set point, and shall be provided on each receiver to indicate the loss of signal from the sensor/transmitter, or to alarm the loss of sensitivity of the gas sensor. Each receiver shall provide an isolated 4-20 mA output signal proportional to gas concentration and shall also contain remote reset input terminals to allow alarm acknowledgement from a remote location.

C. The gas detection system shall be Wallace & Tiernan Acutec 35 Gas Detection System, ATI Series A14, or pre-approved equal

PART 3 EXECUTION

3.1 INSTALLATION

A. All equipment shall be installed as per manufacturers' directions. Weight of valves, hoses and equipment must not be carried by the fittings themselves. Proper support for all equipment shall be provided.

B. Chlorination injection points shall have anti-siphon valves and diffuser piping as required mounted horizontally.

C. Vents shall extend to the outside of structure and be turned down and be equipped with a non-corrodible screen.

D. The chlorine detector sensor shall be mounted not higher than 12 inches above the lowest floor elevation and at least 4 feet away from the exhaust fans.

The chlorine equipment appurtenances shall be installed in accordance with CI-01 and CI Pamphlet 6 so as to provide a complete and integrated system in accordance with the instruction of the manufacturer.

E. The Chlorine ejector shall be placed on the piping so as to protect it from damage and installed per manufacturer's instruction.

3.2 START-UP AND TESTING

A. A factory trained technician shall provide one day on-site start-up and training service for the system.

B. Contractor and equipment supplier (supplier) shall verify that structures, equipment, pumps and motors (if specified) are compatible for an efficient system.

C. Contractor and supplier shall make equipment adjustments required to place system in proper operating condition.

D. Contractor and supplier shall test the chlorination feed systems for proper operation in the presence of the Owner and Engineer. The supplier shall furnish all testing equipment and devices required.

E. If chlorination feed systems fail to meet any of the specified performance requirements, Contractor and/or supplier shall modify and/or replace defective equipment until it meets specified requirements.

F. All piping shall be tested hydrostatically for leaks. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and re-tested afterward.

END OF SECTION