



**MOUNTAIN REGIONAL WATER SPECIAL SERVICE DISTRICT
PARK CITY, UTAH**

WATER TREATMENT PLANT OPTIMIZATION

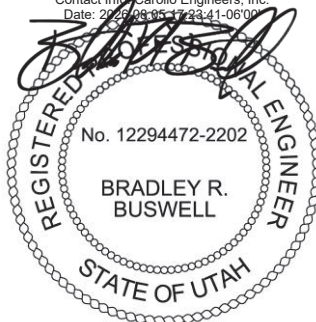
CONTRACT/TECHNICAL SPECIFICATIONS

ELECTRICAL EQUIPMENT PROCUREMENT

FINAL SUBMITTAL

AUGUST 2026

Digitally signed by Bradley R. Buswell
Contact Info: Carollo Engineers, Inc.
Date: 2026.08.05 17:33:41-06'00'



MOUNTAIN REGIONAL WATER SPECIAL SERVICE DISTRICT

WATER TREATMENT PLANT OPTIMIZATION

ELECTRICAL EQUIPMENT PROCUREMENT

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DOCUMENT 00_11_17

ADVERTISEMENT FOR BIDS AND LEGAL NOTICE - PROCUREMENT

MOUNTAIN REGIONAL WATER SPECIAL SERVICE DISTRICT
5739 PAINTBRUSH ROAD
PARK CITY, UT 84098

For procurement of Electrical Distribution Equipment

BID OPENING

Bids shall be submitted electronically to Engineer at:

Carollo Engineers, Inc.
Brad Buswell, P.E., Project Manager
Email: bbuswell@carollo.com
Email Subject Line: MRW Electrical Distribution Equipment Procurement Bid

until 4:00 p.m., Mountain Daylight Time, August 27, 2026. Bids received after 4:00 p.m. MDT will not be accepted.

DESCRIPTION OF THE GOODS AND SERVICES

The Goods and Services are generally described as follows: furnish switchboard, service entrance automatic transfer equipment, and all related accessories for a complete installation.

BIDDING DOCUMENTS

All Bids must be in accordance with the Bidding Documents on file with the Mountain Regional Water Special Service District, and at the offices of Carollo Engineers, Inc., 7090 South Union Park Ave, Suite 600, Midvale UT 84047.

OWNER'S RIGHTS

Owner reserves the right to reject any or all Bids, including without limitation the rights to reject any or all nonconforming, nonresponsive, or conditional Bids, and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of Owner to make an award to that Bidder. Owner also reserves the right to waive formalities.

If the Contract is to be awarded, Owner will give the Successful Bidder a Notice of Award within the number of days set forth in the Bid Form.

BY ORDER OF

Date: 08/06/2026, 2026

Mountain Regional Water Special Service District

By: 
Andy Garland, General Manager

BID OPENING:

END OF DOCUMENT

DOCUMENT 00_21_14

INSTRUCTIONS TO BIDDERS - PROCUREMENT

ARTICLE 1 - DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders will have the meanings indicated in Document 00_72_01 - General Conditions - Procurement and Document 00_73_01 - Supplementary Conditions - Procurement. Additional terms used in these Instructions to Bidders have the meanings indicated below.
- A. Issuing Office—The office from which the Procurement Bidding Documents are to be issued and where the bidding procedures are to be administered.

ARTICLE 2 - PROCUREMENT BIDDING DOCUMENTS

- 2.01 Bidder must use a complete set of the Procurement Bidding Documents in preparing the Bid; neither Buyer nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Procurement Bidding Documents.
- 2.02 Buyer and Engineer make copies of Procurement Bidding Documents available on the above terms only for obtaining Bids for furnishing Goods and Special Services, and do not authorize or confer a license for any other use.
- 2.03 Bidder's representation: The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement concerning examination of the Procurement Documents, that without exception the Bid is premised upon performing and furnishing the Goods and Services required by the Procurement Documents, and that the Procurement Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance.

ARTICLE 3 - QUALIFICATIONS OF BIDDERS

- 3.01 Buyer may at any time conduct such investigations as Buyer deems necessary to establish the responsibility, qualifications, and financial ability of Bidder, and after the opening of Bids may require a Bidder to submit documentation of its qualifications, including, but not limited to, financial data and documentation of previous experience providing goods and services comparable to the specified Goods and Special Services.
- 3.02 Bidder is to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

ARTICLE 4 - INTERPRETATIONS AND ADDENDA

- 4.01 All questions about the meaning or intent of the Procurement Bidding Documents are to be submitted to Engineer in writing at:
- Carollo Engineers, Inc.
Brad Buswell, P.E., Project Manager
Email: bbuswell@carollo.com
Email Subject Line: MRW Electrical Procurement
- 4.02 Interpretations or clarifications considered necessary by Engineer in response to such written questions will be issued electronically to all parties recorded by Engineer as having received the Procurement Bidding Documents.
- A. Questions received less than 7 days prior to the date for opening of Bids will not be answered.
- B. Only answers in the Addenda will be binding.
- C. Oral statements, interpretations, and clarifications may not be relied upon in the preparation of a Bid and will not be binding or legally effective.
- 4.03 Addenda may be issued to clarify, correct, or change the Procurement Bidding Documents as deemed advisable by Buyer or Engineer.

ARTICLE 5 - BID SECURITY

- 5.01 A Bid must be accompanied by Bid security made payable to Buyer in an amount of 5 percent of Bidder's maximum Bid price (determined by adding the base bid and all alternates) and in the form of a Bid bond issued by a surety meeting the requirements.
- A. Issue the Bid bond as specified in Document 00_43_30 - Bid Bond (Penal Sum Form).
- 5.02 The Bid security of the apparent Successful Bidder will be retained until Buyer (Project Owner) awards the Procurement Contract to such Bidder, and such Bidder has executed the Procurement Contract, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released.
- A. If the Successful Bidder fails to execute and deliver the Procurement Contract and furnish the required contract security within 15 days after the Notice of Award, Buyer (Project Owner) may consider Bidder to be in default and 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 Buyer's damages in the case of a damages-form bond. Such forfeiture will be Buyer's exclusive remedy if Bidder defaults.
- 5.03 The Bid security of other Bidders that Buyer believes to have a reasonable chance of receiving the award may be retained by Buyer until the earlier of 7 days after the Effective Date of the Procurement Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 5.04 Bid security of other Bidders that Buyer believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

ARTICLE 6 - PROCUREMENT CONTRACT TIMES

6.01 See applicable provisions in the Procurement Agreement.

ARTICLE 7 - LIQUIDATED DAMAGES

7.01 Any provisions for liquidated damages, such as those for Seller's failure to attain a specified Milestone such as the delivery of the Goods, are set forth in the Procurement Agreement.

ARTICLE 8 - CONFIDENTIALITY OF BID INFORMATION

- 8.01 Confidential information is information in the Bid, or in documents submitted by Bidder with the Bid or submitted subsequent to the opening of Bids in support of the Bid, that Bidder clearly and prominently labels in writing to be a trade secret, proprietary, or confidential. Bids will be opened and accompanying documents, if any, will be maintained in a manner that endeavors to avoid disclosing confidential information to third parties, to the extent allowed by Laws and Regulations.
- 8.02 Bidder shall clearly and prominently mark confidential information with the word "CONFIDENTIAL" on each page or sheet or on the cover of bound documents. Place "CONFIDENTIAL" stamps or watermarks so that they do not obscure any of the required information on the document, either in the original or in a way that would obscure any of the required information in a photocopy of the document.
- 8.03 If Buyer is requested to disclose confidential information, becomes legally compelled to disclose confidential information, or is required by a regulatory body, governing agency, or controlling authority to disclose confidential information, or make any other disclosure that is prohibited or otherwise constrained by these Procurement Bidding Requirements, Buyer will provide Bidder with prompt notice so Bidder may seek a protective order or other appropriate remedy. Bidder will be solely responsible for submitting to the regulatory body, governing agency, or controlling authority any arguments, briefs, memoranda, motions, authorities, or other information in opposition to disclosure.
- 8.04 Buyer's obligations with respect to confidential information are nullified by the following exceptions:
- A. Confidential information becomes a part of the public domain through publication or otherwise, through no fault of the Buyer;
 - B. Buyer can demonstrate through suitable documentation that the confidential information was already in the Buyer's possession, and not previously marked as confidential, or was otherwise publicly available prior to the date of Bid submittal;
 - C. The confidential information is subsequently and independently disclosed to the Buyer by a third party who has a lawful right to disclose such information;
 - D. Buyer concludes in good faith that the information is not confidential, or that disclosure is required or justified; or
 - E. Buyer is required to disclose the confidential information by court order or by applicable Laws and Regulations.

- 8.05 Notwithstanding any other provision of the Procurement Bidding Documents, it is stipulated and agreed that by accepting a Bid, Buyer has not and does not waive its legal immunity (if any) from suit or liability.

ARTICLE 9 - "OR EQUAL" ITEMS

- 9.01 The Procurement Contract, if awarded, will be based on material and equipment specified in the Procurement Bidding Documents without consideration of possible "or-equal" items. Whenever it is specified or described in the Procurement Bidding Documents that an "or-equal" item of material or equipment may be furnished or used by Seller if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Procurement Contract.
- A. The procedure for submittal of any such application by Seller and consideration by Engineer is set forth in Document 00_72_01 - General Conditions - Procurement and may be supplemented in the Procurement Specifications.

ARTICLE 10 - PREPARATION OF BID

- 10.01 The Bid Form is included with the Procurement Bidding Documents. Additional copies of Procurement Bidding Documents may be obtained from the Issuing Office.
- 10.02 All blanks on the Bid Form must be completed and the Bid Form must be signed by an individual authorized to act on behalf of the Bidder. Alterations must be initialed by an individual authorized to act on behalf of the Bidder. A Bid price must be indicated for each item in the Bid Form. In the case of optional alternates, the words "No Bid" may be entered.
- 10.03 Bidder must acknowledge all Addenda by filling in the number and date of each Addendum in the Bid Form and sign where indicated to verify that the Addenda were received. A Bid that does not acknowledge receipt of all Addenda may be considered non-responsive.
- 10.04 Bidder shall:
- A. Sign the Bid Form as indicated in the Bid Form.
 - B. Include evidence of authority to sign.
 - C. Provide information on the individual to be contacted for any communications regarding the Bid.
 - D. Provide evidence of the Bidder's authority and qualification to do business in the locality of the Project, to the extent required, or indicate the ability to obtain such authority and qualification prior to award of the Procurement Contract.
- 10.05 The responsibilities of each Bidder submitting a Bid are described in the Bidder's representations and certifications set forth in Article 6 of the Bid Form.
- 10.06 Bidder shall include documentation to clearly indicate the ability to meet the required Procurement Contract Times set forth in Article 2 of Section 00_52_64 - Agreement Between Buyer and Seller - Procurement.

ARTICLE 11 - BASIS OF BID; COMPARISON OF BIDS

11.01 Lump Sum:

- A. Bidder shall submit a Bid on a lump sum basis as set forth in the Bid Form.
- B. The apparent low Bid will be determined on the basis of the lump sum bid amount. The Buyer's intent is to enter into a Purchase Agreement with the Bidder who offers a responsive and responsible bid at the lowest price.

ARTICLE 12 - SUBMITTAL OF BID

12.01 Bids shall be submitted electronically to Engineer at:

Carollo Engineers, Inc.
Brad Buswell, P.E., Project Manager
Email: bbuswell@carollo.com
Email Subject Line: MRW Electrical Prepurchase Procurement Bid

12.02 Bidder must submit one electronic "PDF" copy of the completed Bid Form and the Bid Security.

- A. Bidder shall include documentation to clearly indicate the ability to meet the required Procurement Contract Times set forth in Article 2 of Section 00_52_64 - Agreement Between Buyer and Seller - Procurement. Bidders that cannot meet the Procurement Contract Times shall be deemed unresponsive.

12.03 Bidder shall assume full responsibility for timely delivery in the manner designated for receipt of Bids. Bids received after the time and date for receipt of Bids will be returned unopened.

ARTICLE 13 - MODIFICATION OR WITHDRAWAL OF BID

13.01 A Bid may be modified or withdrawn by a document duly signed in the same manner that a Bid must be signed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.

13.02 If, within 24 hours after Bids are opened, any Bidder files a duly signed, written notice with Buyer and promptly thereafter demonstrates to the reasonable satisfaction of Buyer that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid and the bid security will be returned.

ARTICLE 14 - OPENING OF BIDS

14.01 Bids will not be publicly opened and read aloud. An abstract of the amounts of the Base Bids may be made available to Bidders after Bids have been opened and reviewed by the Buyer.

ARTICLE 15 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 15.01 All Bids will remain subject to acceptance for the period stated in Document 00_41_63 - Bid Form - Procurement, but Buyer may, in its sole discretion, release any Bid and return the bid security prior to the end of this period.

ARTICLE 16 - EVALUATION OF BIDS AND AWARD OF PROCUREMENT CONTRACT

- 16.01 Buyer reserves the right to reject any and all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids.
- 16.02 Buyer will reject the Bid of any Bidder that Buyer finds, after reasonable inquiry and evaluation, to not be responsible.
- 16.03 In evaluating Bids, Buyer will consider whether the Bids comply with the prescribed requirements, and such alternatives, unit prices, and other data as may be requested in Document 00_41_63 - Bid Form - Procurement or prior to the Notice of Award.
- 16.04 If Buyer awards the Procurement Contract, such award will be to the responsible Bidder submitting the lowest responsive Bid.

ARTICLE 17 - BONDS AND INSURANCE

- 17.01 When the Successful Bidder delivers the signed Procurement Agreement to Buyer, it must be accompanied by required such bonds and acceptable evidence of insurance.

ARTICLE 18 - SIGNING OF PROCUREMENT AGREEMENT

- 18.01 When Buyer issues a Notice of Award to the Successful Bidder, it will be accompanied by the unsigned counterparts of the Procurement Agreement along with the other Procurement Contract Documents identified in the Procurement Agreement.
- A. Within 15 days, Successful Bidder must execute and deliver the required number of counterparts of the Procurement Agreement and any bonds and acceptable evidence of insurance, together with printed and electronic copies of the Procurement Contract Documents.
 - B. Within 10 days, Buyer will deliver one fully executed counterpart of the Procurement Agreement to Successful Bidder, together with printed and electronic copies of the Procurement Contract Documents.

ARTICLE 19 - SALES AND USE TAXES

- 19.01 Buyer is not exempt from Utah state sales and use taxes on materials and equipment to be incorporated in the Project. Sales tax shall be included in the bid. Refer to Document 00_73_01 - Supplementary Conditions - Procurement for additional information.

ARTICLE 20 - PROCUREMENT CONTRACT TO BE ASSIGNED

20.01 Bidder's attention is directed to the provisions of Article 5 of the Procurement Agreement which provide for the assignment of the Procurement Contract to a construction contractor designated by the Buyer to construct the Signal Hill Water Treatment Plant Optimization Project.

A. Successful Bidder (Seller) will be required to perform the Procurement Contract after it has been assigned to the construction contractor (Contractor Assignee) in accordance with the provisions in the Procurement Contract.

1. The assignment will be as specified in Document 00_54_34 - Assignment of Procurement Contract and Document 00_60_09 - Surety's Agreement to Assignment.

B. Timing of the assignment is addressed in the Procurement Agreement. Forms documenting the assignment of the Procurement Contract and for the agreement of the Seller's surety to such assignment are included as attachments to the Procurement Agreement.

END OF DOCUMENT

DOCUMENT 00_41_63

BID FORM - PROCUREMENT

The terms used in this Bid with initial capital letters have the meanings stated in Document 00_21_14 - Instructions to Bidders - Procurement, Document 00_72_01 - General Conditions - Procurement, and Document 00_73_00 - Supplementary Conditions - Procurement.

ARTICLE 1 — BUYER AND BIDDER

1.01 This Bid is submitted to:

Mountain Regional Water Special Service District
5739 Paintbrush Rd., Park City, UT 84098

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into a Procurement Contract with Buyer in the form included in the Procurement Bidding Documents, and to furnish the Goods and Special Services as specified or indicated in the Procurement Bidding Documents, for the prices and within the times indicated in this Bid, and in accordance with the other terms and conditions of the Procurement Bidding Documents.

ARTICLE 2 — BASIS OF BID

2.01 Lump Sum Bids.

- A. Bidder will furnish the Goods and Special Services in accordance with the Procurement Contract Documents for the following Procurement Contract Price(s):
1. Lump Sum Bid Price:

Lump Sum Bid Price	\$
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ARTICLE 3 — TIME OF COMPLETION

3.01 Bidder agrees that the furnishing of Goods and Special Services will conform to the schedule of Procurement Contract Times set forth in the Procurement Agreement.

3.02 Bidder accepts the provisions of the Procurement Agreement as to liquidated damages.

ARTICLE 4 — ATTACHMENTS TO THIS BID

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

- A. Required Bid security in the form prescribed in Document 00_21_14 - Instructions to Bidders - Procurement.
- B. 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.

ARTICLE 5 — BIDDER'S ACKNOWLEDGMENTS

- 5.01 Bidder accepts all terms and conditions of Document 00_21_14 - Instructions to Bidders - Procurement. This Bid will remain subject to acceptance for 60 days after the Bid opening, or for such longer period that Bidder may agree to in writing upon request of Buyer.
- 5.02 Bidder accepts the provisions of the Agreement as to the assignment of the Contract for furnishing Goods and Special Services.
- 5.03 Bidder accepts that the Buyer retains the right to issue a Notice to Commence Fabrication for the Electrical Equipment. The Bidder acknowledges that until the Notice of Commence Fabrication is issued, the Buyer is not obligated to any monetary commitment associated with this Contract beyond that associated with Special Services. A Notice to Commence Fabrication will be issued once submittals are approved and shipping date allows for offloading and storage of Supplier's equipment can be handled by a Contractor that has been assigned the Contract. See Schedule in Section 00_52_00 - Agreement Between Buyer and Seller for Procurement Contract.
- 5.04 Bidder has examined and carefully studied the Procurement Bidding Documents, the related data identified in the Procurement Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged:

Addendum No.	Addendum Date

ARTICLE 6 — BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

- 6.01 Bidder's Representations.
- A. In submitting this Bid, Bidder represents that:
1. Bidder has examined and carefully studied the Procurement Contract Documents.
 2. If required by Document 00_21_14 - Instructions to Bidders - Procurement to visit the Point of Destination and the site where the Goods are to be installed or Special Services will be provided, or if, in Bidder's judgment, any observable local or site conditions may affect the delivery, cost, progress, or furnishing of the Goods and Special Services, then Bidder has visited the Point of Destination and site where the Goods are to be installed or Special Services will be provided (as applicable) and become familiar with and is satisfied as to the observable local and site conditions that may affect delivery, cost, progress, and furnishing of the Goods and Special Services.
 3. Bidder is familiar with and is satisfied as to all Laws and Regulations that may affect the cost, progress, and performance of Seller's obligations under the Procurement Contract.
 4. Bidder has carefully studied, considered, and correlated the information known to Bidder with respect to the effect of such information on the cost, progress, and performance of Seller's obligations under the Procurement Contract.

5. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Procurement Contract Documents, and the written resolution (if any) thereof by Engineer is acceptable to Bidder.
6. The Procurement Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance of Seller's obligations under the Procurement Contract.
7. The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of the Bidding Requirements, that without exception the Bid (including all Bid prices) is premised upon furnishing the Goods and Special Services as required by the Procurement Contract Documents.

6.02 Bidder's Certifications.

A. Bidder certifies that:

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; and
4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Procurement Contract. For the purposes of this Document:
 - 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 Buyer, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Buyer 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 Buyer, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
 - d. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process.

This Bid is offered by:

Bidder:

(typed or printed name of organization)

By:

(individual's signature)

Date:

(date signed)

Name:

(typed or printed)

Title:

(typed or printed)

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

Attest:

(individual's signature)

Title:

(typed or printed)

Address for giving notices:

Designated Representative:

Name:

(typed or printed)

Title:

(typed or printed)

Address:

Phone:

Email:

License No.:

Classification:

Limitation:

END OF DOCUMENT

DOCUMENT 00_43_30

BID BOND (PENAL SUM FORM)

Bidder Name: _____ Address <i>(principal place of business)</i> : _____ 	Surety Name: _____ Address <i>(principal place of business)</i> : _____
Owner Name: _____ Address <i>(principal place of business)</i> : _____ 	Bid Project <i>(name and location)</i> : _____ 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
_____ <i>(Full formal name of Bidder)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature) (Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____ <i>(Signature)</i>	Title: _____ <i>(Signature)</i>
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____ <i>(Signature)</i>	Title: _____ <i>(Signature)</i>
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.	

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.
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. 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 1 year after the Bid due date.
6. 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.
7. 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.
8. 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.
9. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

END OF DOCUMENT

DOCUMENT 00_51_00

NOTICE OF AWARD

Date of Issuance: _____

Owner: Mountain Regional Water SSD Buyer's Project No.: N/A

Engineer: Carollo Engineers, Inc. Engineer's Project No.: 203230

Project: Signal Hill Water Treatment Plant Optimization Project

Contract Name: Electrical Distribution Equipment Procurement

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:

Electrical Distribution Equipment and ancillary items as described in the Procurement Bidding Documents

The Contract Price of the awarded Contract is \$ _____. Contract Price is subject to adjustment based on the provisions of the Contract.

One 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.

☐ Drawings will be delivered separately from the other Contract Documents.

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 one counterpart 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 the General Conditions.

Owner: Mountain Regional Water Special Service District

By (*signature*): _____

Name (*printed*): _____

Title: _____

Copy: Engineer

END OF DOCUMENT

DOCUMENT 00_52_64

AGREEMENT BETWEEN BUYER AND SELLER - PROCUREMENT

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This Procurement Agreement is by and between Mountain Regional Water Special Service District ("Buyer") and _____ ("Seller").

Terms used in this Procurement Agreement have the meanings stated in Document 00_72_01 - General Conditions - Procurement and Document 00_73_01 - Supplementary Conditions - Procurement.

Buyer and Seller hereby agree as follows:

ARTICLE 1 — PROCUREMENT CONTRACT

1.01 Goods and Special Services

- A. Seller shall furnish the Goods and Special Services as specified or indicated in the Procurement Contract Documents. The Goods and Special Services are generally described as follows:

Electrical distribution equipment including switchboard, service entrance automatic transfer equipment, and all related accessories for a complete installation.

1.02 The Project

- A. The Project, of which the Goods and Special Services are a part, is generally described as follows: the Signal Hill Water Treatment Plant Optimization Project includes several new facilities and improvements including a new GAC building expansion, a new Chemical Building, and other process improvements.

1.03 Engineer

- A. Buyer has retained Carollo Engineers ("Engineer"), to prepare Procurement Contract Documents and act as Buyer's representative. Engineer assumes all duties and responsibilities and has the rights and authority assigned to Engineer in the Procurement Contract Documents in connection with Seller's furnishing of Goods and Special Services.

1.04 Point of Destination

- A. The Point of Destination is designated as: Signal Hill Water Treatment Plant, 7563 N Promontory Ranch Road, Park City, UT 84098.

ARTICLE 2 — PROCUREMENT CONTRACT TIMES

2.01 Time of the Essence

- A. All time limits for Milestones, including the submittal of Shop Drawings and Samples, the delivery of Goods, and the furnishing of Special Services as stated in the Procurement Contract Documents, are of the essence of the Procurement Contract.

2.02 Schedule of Procurement Contract Times

- A. Seller shall submit a progress schedule to Buyer and Engineer per Document 00_72_01 - General Conditions - Procurement.
- B. The following schedule sets forth the Procurement Contract Times (number of calendar days allocated to certain activities).

Milestone	Date or Days	Notes
Effective Procurement Contract Date	September 18, 2026	Pending Board Approval on September 17, 2026
Preliminary Schedule	15	Per Document 00_72_01 - General Conditions – Procurement. Days from Effective Procurement Contract Date.
Submit initial submittals and shop drawings	30	Days from Effective Procurement Contract Date
Engineer's submittal reviews(s)	14	Days for each submittal and resubmittal review
Manufacturer Resubmittal(s)	30	Days for each resubmittal

- C. The following schedule sets for the Delivery Contract Times that the Goods are to be delivered to the Point of Destination and ready for Buyer's receipt in accordance with the following schedule. Listed dates are estimates and are subject to change and final dates will be coordinated with the installing Contractor.

Milestone	Date or Days	Notes
Notice to Commence Fabrication	November 2, 2026	This date is tentative and depends upon approval of shop drawings.
Deliver acceptable Goods to Point of Destination	November 1, 2027	Delivery must be made before this date.
Complete Services for Goods	November 30, 2027	Certification that electrical equipment has been properly installed.
Readiness for Final Inspection and Acceptance of Goods and Special Services	January 31, 2028	

- D. The Seller shall not commence manufacture of any Goods until the Buyer issues a Notice to Commence Fabrication. A Notice to Commence Fabrication shall not be issued until submittal and shop drawings have been approved. Goods shall be delivered in accordance with the General Conditions.
- E. The Seller shall bear the cost of storing Goods up to the date of delivering acceptable Goods to the Point of Destination. After such time, at the Buyer's option, Buyer shall store the Goods or negotiate a price with the Seller for additional storage days.

2.03 Shop Drawings and Samples

- A. Submittal of Shop Drawings and Samples: Seller shall submit all Shop Drawings and Samples required by the Procurement Contract Documents to Engineer for its review and approval.
- B. Engineer's Review: It is the intent of the parties that Engineer will conduct its review of Shop Drawings and Samples and issue its approval, or a denial accompanied by substantive comments regarding information needed to gain approval, within 14 days after Seller's submittal of such Shop Drawings and Samples, or within such

longer period that is needed because of the quantity and quality of such submittals. Resubmittals will be limited whenever possible.

ARTICLE 3 — PROCUREMENT CONTRACT PRICE

3.01 Procurement Contract Price and Total Price—Based on Attached Bid

- A. The Procurement Contract Price is comprised of the Lump Sum and Unit Price amounts set forth in the attached Bid Form.
- B. The Total Price is \$_____. Such Total Price is comprised of the Lump Sum amount (taking into account any accepted alternates), Unit Price Goods and Special Services amount (if any) (subject to final adjustment), and Buyer's Contingency Allowance (if any) (subject to final adjustment).
 - 1. The final adjustment of Procurement Contract Price with respect to Unit Price Goods and Special Services will be set forth in a Change Order.
- C. Procurement Contract Price and Total Price—Based on Attached Bid.
 - 1. For furnishing the Goods and Special Services in accordance with the Procurement Contract Documents, Buyer shall pay Seller the prices stated in Seller's Bid, attached hereto as an exhibit, subject to final adjustments for Unit Price Goods and Special Services.

ARTICLE 4 — PAYMENT PROCEDURES

4.01 Submittal and Processing of Applications for Payment

- A. Seller shall submit Applications for Payment in accordance with Article 13 of Document 00_72_01 - General Conditions - Procurement and the following paragraphs. Engineer and Buyer will process such Applications for Payment in accordance with said Article 13.

4.02 Progress Payments; Final Payment

- A. Seller may submit an Application for Payment requesting the stated percentage of Procurement Contract Price upon attainment of each of the following Payment Line Items:

Payment Line Item (Lump Sum)	Percentage of Lump Sum
Special Service A. Placement of Order, Development of Submittals	10
Special Service B. Approved Submittals / Deliver of Notice to Commence Fabrication	15
Delivery of Goods to Point of Destination in accordance with the Procurement Contract Documents	70
Final Payment: Correction of non-conformities, provision of final Operations and Maintenance manuals, submittal of warranties and other final documentation required by the Procurement Contract Documents	5
Total Procurement Contract Price (Lump Sum)	100

- B. For Unit Price Goods and Special Services, if any, or for payments owed to Seller as a result of authorizations by Buyer under the Buyer's Contingency Allowance (if

any), Seller shall submit a separate Application for Payment, no more frequently than monthly, that states (1) the actual quantities of such Unit Price Goods and Special Services that have been furnished, and the applicable unit prices; and (2) the services or items performed or furnished under the Buyer's Contingency Allowance, and the amounts owed. If practical, and at Seller's option, Seller may apply for such unit price and Buyer's Contingency Allowance payments in a separate section of an Application for Payment submitted for lump sum items.

- C. Buyer shall pay Seller the amount owed under an Application for Payment within 30 days after Engineer's presentation to Buyer of the Application for Payment and Engineer's recommendation.

ARTICLE 5 — ASSIGNMENT OF PROCUREMENT CONTRACT

5.01 Assignment of Contract

- A. Buyer has the right to assign this Procurement Contract for furnishing Goods and Special Services, but only to a person or entity with sufficient and apparent ability to satisfy all of Buyer's obligations under this Procurement Contract, and Seller hereby consents to such assignment. Forms documenting the assignment of the Procurement Contract, and consent of Seller's surety to the assignment, have been executed by Buyer, Seller, and Seller's surety, and are attached as exhibits to this Procurement Agreement.
- B. If so assigned, the following provisions apply:
 - 1. The Procurement Contract is initially executed in the name of the entity identified in this Document as Buyer and will be assigned by such Buyer (as assignor) to a construction contractor (Contractor/Assignee) designated by such Buyer. The assignment will occur on the effective date of the construction contract between such Buyer (Project Owner) and the Contractor/Assignee, which is expected to occur in November 2026. Commencing on the date of acceptance of assignment by the Contractor/Assignee, all references in the Procurement Contract to "Buyer" shall mean the designated Contractor/Assignee.
 - 2. The assignment of this Procurement Contract relieves the assignor from all further obligations and liabilities under this Procurement Contract. After assignment, Seller shall become a subcontractor or supplier to the Contractor/Assignee and, except as specified in this Document, all rights, duties, and obligations of Buyer under the Procurement Contract become the rights, duties, and obligations of the Contractor/Assignee.
 - 3. After assignment:
 - a. The Procurement Drawings and Procurement Specifications, and any modifying Addenda will become "Contract Documents" under the construction contract.
 - b. If the Procurement Drawings or Procurement Specifications, as "Contract Documents" under the construction contract, are duly modified under such construction contract, then Seller and Contractor/Assignee shall enter into a corresponding Change Order under the applicable provisions of this Procurement Contract.
 - c. The Procurement Drawings and Procurement Specifications may not be modified by Seller or Contractor/Assignee, singly or in tandem, except as such Procurement Drawings or Procurement Specifications, as "Contract

Documents” under the construction contract, have been duly modified under such construction contract.

- d. All performance warranties, guarantees, and indemnifications required by the Procurement Contract will continue to run for the benefit of assignor (Project Owner) and, in addition, for the benefit of the Contractor/Assignee. However, if assignor (Project Owner) and Contractor/Assignee make the same warranty or guarantee claim, then Seller shall only be liable once for such claim. Other than its remedies under such warranties, guarantees, and indemnifications, assignor will not retain direct rights under this Procurement Contract, but will have rights and remedies as a party to the construction contract, whose scope of work will encompass the Procurement Drawings, Procurement Specifications, and modifying Addenda; provided, however, that any limitations on Seller’s liability in this Procurement Contract will continue to bind the original Buyer (assignor) after assignment.
- e. Seller shall submit all Applications for Payment directly to Contractor/Assignee.
 - 1) Contractor/Assignee shall review each Application for Payment promptly, determine the amount that Contractor/Assignee approves for payment, and then include the amount approved in the next application for payment submitted to Project Owner (or Engineer) under the construction contract.
 - 2) Contractor/Assignee shall pay Seller within 45 days of receipt of payment from the Project Owner under the construction contract.
 - 3) After assignment Engineer will review, approve, or deny the content of Applications for Payment under the Procurement Contract only to the extent that Contractor/Assignee, as construction contractor, has incorporated such content into payment applications that Engineer reviews under the construction contract.
- f. The Contractor/Assignee shall have all the rights of the Buyer under any pending Claim by Buyer.
- g. All Claims and supporting documentation will be submitted directly by the claimant party (either Buyer, Contractor/Assignee, or Seller), to the other party, without submittal to Engineer.
 - 1) The other party will render a response in writing within 30 days of receipt of the last submittal of claimant.
 - 2) If the other party does not render a written response to a Claim within 30 days after receipt of the last submittal of the claimant, the other party shall be deemed to have approved the Claim in its entirety.
 - 3) The other party’s written response to a Claim, or the approval of the Claim in its entirety as a function of failure to respond within 30 days, will be final and binding upon Buyer and Seller 30 days after it is issued, unless within such 30 days of issuance either Buyer or Seller appeals the result by initiating the mediation of the Claim in accordance with the dispute resolution procedures.
 - 4) Any Claim by Seller that Contractor/Assignee may choose to submit, present, or forward to Project Owner must be submitted to Buyer within sufficient time for Contractor/Assignee to preserve its rights under the construction contract, notwithstanding any procedures or time limits in this Procurement Contract.
- h. Seller’s recovery of additional cost, time, or both cost and time for any Claim attributable to the Project Owner will be limited to the proportionate

recovery by Contractor/Assignee against Project Owner for such Claim. Seller will cooperate and assist Contractor/Assignee in pursuing any Claim by Contractor/Assignee against Project Owner on behalf of Seller, including the timely preparation and delivery of supporting documentation.

- i. If the pursuit of any claim by Contractor/Assignee against Project Owner on Seller's behalf requires the expenditure by Contractor/Assignee of legal or consulting fees, or results in litigation, arbitration, or any dispute resolution procedures, Seller agrees to pay for a proportionate share of attorneys' fees, consultant fees, and litigation, arbitration, and other resolution costs incurred by Contractor/Assignee in pursuing the claim on behalf of Seller, based upon the amount claimed by Seller as compared to the total value of the claim pursued by the Contractor/Assignee.
 - j. All rights, duties, and obligations of Engineer to Contractor/Assignee and Seller under this Procurement Contract will cease.
 - k. Subject to the foregoing provisions, all references in the Procurement Contract to submitting items to Engineer, or to Engineer having tasks or obligations, will be read after such an assignment as requiring submittal to Contractor/Assignee, or as Contractor/Assignee having such tasks or obligations (which Contractor/Assignee may delegate when appropriate).
 - l. If the Procurement Contract includes a Buyer's Contingency Allowance, upon assignment such allowance will be automatically reduced to the amount previously authorized by Buyer (Project Owner) and cease to be operational.
- C. No other assignment by a party hereto of any rights under or interests in the Procurement Contract will be binding on another party hereto without the written consent of the party sought to be bound. Specifically, but without limitation, Procurement Contract payments or other money that may become due, and Procurement Contract payments or other money that are due, may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by Laws and Regulations). Unless specifically stated to the contrary in any written consent to such an assignment, such an assignment will not release or discharge the assignor from any duty or responsibility under the Procurement Contract Documents.

ARTICLE 6 — PROCUREMENT CONTRACT DOCUMENTS

6.01 List of Procurement Contract Documents

- A. The Procurement Contract Documents consist of the following:
- 1. This Procurement Agreement.
 - 2. Document 00_72_01 - General Conditions - Procurement.
 - 3. Document 00_73_01 - Supplementary Conditions - Procurement.
 - 4. Procurement Specifications.
 - 5. Addenda Numbers **[list those Addenda that are Procurement Contract Documents]**.
 - 6. Exhibits to this Procurement Agreement (enumerated as follows):
 - a. Seller's Bid, solely as to the prices set forth.
 - b. Exhibit A, Assignment of Contract, Consent to Assignment, and Acceptance of Assignment.
 - c. Exhibit B, Surety's Consent to Assignment.

7. The following which may be delivered or issued on or after the Effective Date of the Procurement Contract and are not attached hereto:
 - a. Change Orders;
 - b. Change Directives; and
 - c. Field Orders.
- B. The documents listed under List of Procurement Contract Documents are attached to this Procurement Agreement (except as expressly noted otherwise above).
- C. There are no Procurement Contract Documents other than those listed above.
- D. The Procurement Contract Documents may only be amended or supplemented as provided in Paragraph 11.01 of Document 00_72_01 - General Conditions - Procurement.

ARTICLE 7 — SELLER'S REPRESENTATIONS AND CERTIFICATIONS

7.01 Seller's Representations

- A. In order to induce Buyer to enter into this Procurement Agreement, Seller makes the following representations:
 1. Seller has examined and carefully studied the Procurement Contract Documents.
 2. If required by the Instructions to Bidders to visit the Point of Destination and the site where the Goods are to be installed or Special Services will be provided, or if, in Seller's judgment, any observable local or site conditions may affect the delivery, cost, progress, or furnishing of the Goods and Special Services, then Seller has visited the Point of Destination and site where the Goods are to be installed or Special Services will be provided (as applicable) and become familiar with and is satisfied as to the observable local and site conditions that may affect delivery, cost, progress, and furnishing of the Goods and Special Services.
 3. Seller is familiar with and is satisfied as to all Laws and Regulations that may affect the cost, progress, and performance of Seller's obligations under the Procurement Contract.
 4. Seller has carefully studied, considered, and correlated the information known to Seller with respect to the effect of such information on the cost, progress, and performance of Seller's obligations under the Procurement Contract.
 5. Seller has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Seller has discovered in the Procurement Contract Documents, and the written resolution (if any) thereof by Engineer is acceptable to Seller.
 6. The Procurement Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance of Seller's obligations under the Procurement Contract.
 7. Seller's entry into this Procurement Contract constitutes an incontrovertible representation by Seller that without exception all prices in the Procurement Agreement are premised upon furnishing the Goods and Special Services as required by the Procurement Contract Documents.

7.02 Seller's Certifications

- A. Seller certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Procurement Contract. For the purposes of this Document:
 - 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 Procurement Contract execution;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Procurement Contract to the detriment of Buyer, (b) to establish bid or contract prices at artificial non-competitive levels, or (c) to deprive Buyer 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 Buyer, 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 Procurement Contract.

ARTICLE 8 — CONFIDENTIALITY

8.01 Confidential Information

- A. Confidential information is information in documents submitted by Seller that Seller clearly and prominently labels in writing to be a trade secret, proprietary, or confidential. Such documents, if any, will be maintained in a manner that endeavors to avoid disclosing confidential information to third parties, to the extent allowed by Laws and Regulations.
- B. Seller shall clearly and prominently mark confidential information with the word "CONFIDENTIAL" on each page or sheet or on the cover of bound documents. Place "CONFIDENTIAL" stamps or watermarks so that they do not obscure any of the required information on the document, either in the original or in a way that would obscure any of the required information in a photocopy of the document.

8.02 Disclosure of Confidential Information

- A. If Buyer is requested to disclose confidential information, or becomes legally compelled (by oral questions, interrogatories, requests for information or documents, subpoena, civil or criminal investigative demand, public information requests, or other requests under Laws and Regulations) to disclose confidential information, or is required by a regulatory body, governing agency, or controlling authority to disclose confidential information, or make any other disclosure that is prohibited or otherwise constrained by the Procurement Contract, Buyer will provide Seller with prompt notice so Seller may seek an appropriate protective order or other remedy. Seller will be solely responsible for submitting to the regulatory body, governing agency, or controlling authority any arguments, briefs, memoranda, motions, authorities, or other information in opposition to disclosure.
- B. Buyer's obligations with respect to confidential information are nullified by the following exceptions:
 - 1. Confidential information becomes a part of the public domain through publication or otherwise, through no fault of the Buyer;

2. Buyer can demonstrate through suitable documentation that the confidential information was already in the Buyer's possession, and not previously marked as confidential, or was otherwise publicly available prior to the Effective Date of the Procurement Contract;
3. The confidential information is subsequently and independently disclosed to the Buyer by a third party who has a lawful right to disclose such information;
4. Buyer has a good faith belief that disclosure is required or justified; or
5. Buyer is required to disclose the confidential information by court order or by applicable Laws and Regulations.

8.03 Waiver of Immunity

- A. Notwithstanding any other provision of the Procurement Contract, it is stipulated and agreed that by accepting confidential information, Buyer has not and does not waive its legal immunity (if any) from suit or liability.

ARTICLE 9 — MUTUAL WAIVER

9.01 Mutual Waiver of Consequential Damages

- A. Buyer and Seller waive against each other, and against the other's officers, directors, members, partners, employees, agents, consultants, and subcontractors, any and all claims for or entitlement to incidental, indirect, or consequential damages arising out of, resulting from, or related to the Procurement Contract. If Buyer (Project Owner) assigns this Procurement Contract to a construction contractor (Contractor/Assignee), then the terms of this Paragraph will be binding upon the Contractor/Assignee with respect to Seller and assignor. The terms of this mutual waiver do not apply to or limit any claim by either Buyer or Seller against the other based on any of the following: (a) contribution or indemnification, (b) liquidated damages, (c) costs, losses, or damages attributable to personal or bodily injury, sickness, disease, or death, or to injury to or destruction of the tangible property of others, (d) intentional or reckless wrongful conduct, or (e) rights conferred by any bond provided by Seller under this Procurement Contract.

IN WITNESS WHEREOF, Buyer and Seller have signed this Procurement Agreement.
Counterparts have been delivered to Buyer and Seller.

The Effective Date of the Procurement Contract is _____.

Buyer

Seller

(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address: _____

Phone: _____

Email: _____
(If Buyer is a corporation, attach evidence of authority to sign. If Buyer is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

(typed or printed name of organization)

By: _____
(individual's signature)

Date: _____
(date signed)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

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

Attest: _____
(individual's signature)

Title: _____
(typed or printed)

Address for giving notices:

Designated Representative:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Address: _____

Phone: _____

Email: _____

END OF DOCUMENT

DOCUMENT 00_54_34

ASSIGNMENT OF PROCUREMENT CONTRACT

This assignment will be effective on the Effective Date of the Construction Contract between Buyer (as "Owner") and Contractor/Assignee (as "Contractor").

The Procurement Contract between Mountain Regional Water Special Service District ("Buyer") and _____ ("Seller") for furnishing Goods and Special Services entitled Electrical Distribution Equipment for the Singal Hill Water Treatment Plant Optimization Project (Procurement Contract) is hereby assigned, transferred, and set over to Contractor/Assignee, as assignee, by Buyer, as assignor. Upon assignment the Contractor/Assignee shall have the duties, rights, and obligations of Buyer under the terms of the Procurement Contract, and will be responsible to Owner under the Construction Contract for the performance of obligations by Seller, which will become a Subcontractor or Supplier to Contractor/Assignee. Buyer, Seller, and Contractor/Assignee hereby acknowledge and agree to be bound by the terms and conditions of assignment set forth in Article 5 of the Agreement Between Buyer and Seller for Procurement Contract.

This assignment includes the Buyer's tax-exempt status, if any.

This assignment will be effective on the Effective Date of the Contract Agreement between the Owner and the Contractor for the General Construction Work.

Assignment Made by Buyer

(typed or printed name of organization)

By: _____ Date: _____
(individual's signature) *(date signed)*

Name: _____ Title: _____
(typed or printed) *(typed or printed)*

If Buyer is a corporation, attach evidence of authority to sign. If Buyer is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Buyer-Seller Agreement.

Assignment Acknowledged and Accepted by Seller

(typed or printed name of organization)

By: _____ Date: _____
(individual's signature) *(date signed)*

Name: _____ Title: _____
(typed or printed) *(typed or printed)*

If Seller is a corporation, attach evidence of authority to sign.

Assignment Accepted by Contractor/Assignee

(typed or printed name of organization)

By: _____ Date: _____
(individual's signature) *(date signed)*

Name: _____ Title: _____
(typed or printed) *(typed or printed)*

If Contractor/Assignee is a corporation, attach evidence of authority to sign.

END OF DOCUMENT

DOCUMENT 00_72_01

GENERAL CONDITIONS - PROCUREMENT

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ARTICLE 1 — DEFINITIONS

1.01 Defined Terms

- A. Wherever used in these Procurement General Conditions or in the other Procurement Documents and printed with initial capital letters, the following terms have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Procurement 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 documents or the Procurement Documents.
 2. Application for Payment—The document prepared by Seller, in a form acceptable to Buyer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Procurement Contract Documents.
 3. Bid—An offer or proposal of a prospective Seller submitted on the prescribed form setting forth the price(s) for furnishing the Goods and Services.
 4. Bidder—An individual or entity that, as a prospective Seller, submits a Bid to Buyer.
 5. Buyer—The individual or entity purchasing the Goods and Special Services.
 6. Change Directive—A written directive from Buyer to Seller issued on or after the Effective Date of the Procurement Contract, ordering an addition, deletion, or revision in the Goods and Special Services.
 7. Change Order—A document which is signed by Seller and Buyer and authorizes an addition, deletion, or revision to the Procurement Contract Documents or an adjustment in the Procurement Contract Price or the Procurement Contract Times, issued on or after the Effective Date of the Procurement Contract. Change Orders may be the result of mutual agreement by Buyer and Seller, or of resolution of a Claim.
 8. Claim—A demand or assertion by Buyer or Seller seeking an adjustment of Procurement Contract Price or Procurement Contract Times, or both, or other relief with respect to the terms of the Procurement Contract. A demand for money or services by a third party is not a Claim.
 9. Contractor/Assignee—A construction contractor with which Project Owner enters into a construction contract, and to which Project Owner, as initial Buyer, assigns this Procurement Contract.
 10. Effective Date of the Procurement Contract—The date indicated in the Procurement Agreement on which the Procurement Contract becomes effective.
 11. 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.
 12. Electronic Means—Electronic mail (e-mail), upload/download from a secure Project website, or other communications methods that allow: the transmission or communication of Electronic Documents; the documentation of transmissions, including sending and receipt; printing of the transmitted Electronic Document by the recipient; the storage and archiving of the Electronic Document by sender and recipient; and the use by recipient of the Electronic Document for purposes permitted by this Procurement 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.

13. Engineer—The individual or entity designated as such in the Procurement Agreement.
14. Field Order—A written order issued by Engineer which requires minor changes in the Goods or Special Services, but which does not involve a change in the Procurement Contract Price or Procurement Contract Times.
15. Goods—The tangible and movable personal property that is described in the Procurement Contract Documents, regardless of whether the property is to be later attached to realty.
16. Goods and Special Services—The full scope of materials, equipment, other items, and services to be furnished by Seller, including Goods, as defined herein, and Special Services, if any, as defined herein. This term refers to both the Goods and the Special Services, or to either the Goods or the Special Services, and to any portion of the Goods or the Special Services, as the context requires.
17. 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.
18. Milestone—A principal event specified in the Procurement Contract that Seller must attain by the date or within the number of days indicated, including, but not limited to, the delivery of the Goods and the furnishing of Special Services.
19. Notice of Award—The written notice, by Buyer to a Bidder, of Buyer's acceptance of the Bid.
20. Point of Destination—The specific address of the location where delivery of the Goods will be made, as stated in the Procurement Agreement.
21. Procurement Agreement—The written instrument, executed by Buyer and Seller, that sets forth the Procurement Contract Price and Procurement Contract Times, identifies the parties and the Engineer, and designates the specific items that are Procurement Contract Documents.
22. Procurement Bidding Documents—The Procurement Bidding Requirements and the proposed Procurement Contract Documents (including all Addenda).
23. Procurement Bidding Requirements—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and Bid Form with any supplements.
24. Procurement Contract—The entire and integrated written agreement between Buyer and Seller concerning the Goods and Special Services.
25. Procurement Contract Documents—Those items so designated in the Procurement Agreement, and which together comprise the Procurement Contract. Shop Drawings and other Seller submittals are not Procurement Contract Documents, even if accepted, reviewed, or approved by Engineer or Buyer.
26. Procurement Contract Price—The money that Buyer has agreed to pay Seller for furnishing the Goods and Special Services in accordance with the Procurement Contract Documents.
27. Procurement Contract Times—The times stated in the Procurement Agreement by which the Goods must be delivered, Special Services must be furnished, and other Milestones must be attained.
28. Procurement Drawings—That part of the Procurement Contract Documents prepared or approved by Engineer which graphically shows the scope, extent,

and character of the Goods and Special Services to be furnished by Seller. Shop Drawings and other Seller submittals are not Procurement Drawings as so defined.

29. Procurement Specifications—That part of the Procurement Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the furnishing of the Goods and Special Services, and certain administrative requirements and procedural matters applicable thereto.
30. Project—The total undertaking to be accomplished for Project Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Goods and Special Services are a part.
31. Project Owner—The entity that has retained (or will retain) engineers, contractors, and others for the planning, study, design, construction, testing, commissioning, and start-up of facilities and improvements. As of the Effective Date of the Procurement Contract, the Project Owner is the Buyer.
32. Samples—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Goods and Special Services and which establish the standards by which such portion of the Goods and Special Services will be judged.
33. Schedule of Submittals—A schedule, prepared and maintained by Seller, of required Submittals and the time requirements for Engineer's review of the Submittals.
34. Seller—The individual or entity furnishing the Goods and Special Services.
35. Shop Drawings—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Seller and submitted by Seller to illustrate some portion of the Goods and Special Services. Shop Drawings, whether approved or not, are not Procurement Drawings and are not Procurement Contract Documents.
36. Special Services—Services to be performed by Seller (or its agents or subcontractors) in association with the Goods to be furnished by Seller, as required by the Procurement Contract Documents.
37. Submittal—A written or graphic document, prepared by or for Seller, which the Procurement Contract Documents require Seller 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; 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; record documents; and other such documents required by the Procurement Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Procurement Contract Documents. Change proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
38. Successful Bidder—The Bidder whose Bid the Buyer accepts, and to which Buyer makes an award of the Procurement Contract.
39. Supplementary Conditions—The part of the Procurement Documents that amends or supplements these General Conditions.

40. Unit Price Goods and Special Services—Goods and Special Services to be paid for on the basis of unit prices (if any).

1.02 Terminology

- A. The words and terms are not defined but have the indicated meanings when used in the Bidding Requirements or Procurement Contract Documents.
- B. Intent of Certain Terms or Adjectives
1. The Procurement 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 Goods and Special Services. It is intended that such exercise of professional judgment, action, or determination will be commercially reasonable and will be solely to evaluate, in general, the Goods and Special Services for compliance with the requirements of and information in the Procurement Contract Documents and conformance with the design concept of the completed Project as a functioning whole, as shown or indicated in the Procurement Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective will not be effective to assign to Engineer any duty or authority to supervise or direct the furnishing of Goods or Special Services or any duty or authority to undertake responsibility contrary to any other provision of the Procurement Contract Documents.
 2. The word “non-conforming” when modifying the words “Goods and Special Services,” “Goods,” or “Special Services,” refers to Goods and Special Services that are unsatisfactory, faulty, or deficient in that they:
 - a. do not conform to or comply with the requirements of the Procurement Contract Documents;
 - b. do not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Procurement Contract Documents; or
 - c. in the case of Special Services, have not been completed.
 3. The word “receipt” when referring to the Goods, means the physical taking and possession by the Buyer.
 4. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
 5. The word “furnish,” when used in connection with the Goods and Special Services means to supply and deliver said Goods to the Point of Destination (or some other specified location) and to perform said Special Services fully, all in accordance with the Procurement Contract Documents.
- C. Procurement Contract Price or Procurement Contract Times: References to a change in “Procurement Contract Price or Procurement Contract Times” or “Procurement Contract Times or Procurement Contract Price” or similar, indicate that such change applies to (1) Procurement Contract Price, (2) Procurement Contract Times, or (3) both Procurement Contract Price and Procurement Contract Times, as warranted, even if the term “or both” is not expressed.
- D. Unless stated otherwise in the Procurement Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used

in the Procurement Contract Documents in accordance with such recognized meaning.

ARTICLE 2 — PRELIMINARY MATTERS

2.01 Delivery of Bonds and Insurance Certificates

- A. When Seller delivers the executed counterparts of the Procurement Agreement to Buyer, the Seller also shall deliver to Buyer the performance bond and payment bond (if the Procurement Contract requires Seller to furnish such bonds).
- B. Evidence of Seller's Insurance: When Seller delivers the signed counterparts of the Procurement Agreement to Buyer, the Seller also shall deliver to Buyer, with copies to each additional insured (as identified in the Procurement Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Seller in accordance with bonds and insurance. Evidence of insurance to be obtained at a later date, such as insurance relating to transit or storage of the Goods, will be provided to Buyer at the time of such insurance is obtained.
- C. Evidence of Buyer's Insurance: After receipt of the signed counterparts of the Procurement Agreement and all required bonds and insurance documentation, Buyer shall promptly deliver to Seller, with copies to each additional insured (as identified in the Procurement Contract), certificates and other evidence of insurance (if any) required to be provided by Buyer.

2.02 Copies of Documents

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

2.03 Electronic Transmittals

- A. Except as otherwise stated elsewhere in the Procurement Contract, the Buyer, Seller, and Engineer may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Procurement Contract does not establish protocols for Electronic Means, then Buyer, Seller, and Engineer 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.

2.04 Preliminary Schedules

- A. Within 15 days after the Effective Date of the Procurement Contract, Seller shall submit to Buyer and Engineer for timely review:
 - 1. a progress schedule of activities, consistent with the Procurement Contract Times, including at a minimum, Shop Drawing and Sample submittals, tests, and deliveries as required by the Procurement Contract Documents.
 - a. The progress schedule will be acceptable to Buyer and Engineer if it provides an orderly progression of the Submittals, tests, and deliveries to

completion within the specified Milestones of the Procurement Contract Times.

- b. Such acceptance will not impose on Buyer or Engineer responsibility for the progress schedule, for sequencing, scheduling, or progress of Seller's performance of its obligations under the Procurement Contract, nor interfere with or relieve Seller from Seller's full responsibility therefor.
- c. Such acceptance will not be deemed as an acknowledgment of the reasonableness and attainability of the schedule.

2. a preliminary schedule of Submittals.

- B. No progress payment will be made to Seller until an acceptable progress schedule and acceptable schedule of Submittals are submitted to Buyer and Engineer (and other conditions applicable to progress payments are met).

2.05 Preliminary Conference

- A. Within 20 days after the Procurement Contract Times start to run, a conference attended by Seller, Buyer, Engineer and others as appropriate will be held to establish a working understanding among the parties as to the Goods and Special Services and to discuss the schedules, procedures for handling Shop Drawings and other Submittals, processing Applications for Payment, and maintaining required records.

2.06 Safety

- A. Buyer and Seller shall comply with all applicable Laws and Regulations relating to the safety of persons or property, and to the protection of persons or property from damage, injury, or loss.
- B. When Seller's personnel, or the personnel of any subcontractor to Seller, are present at the Point of Destination or any work area or site controlled by Buyer, the Seller shall be responsible for the compliance by such personnel with any applicable requirements of Buyer's safety programs that are made known to Seller.
- C. If Buyer or its representatives visit the Seller's manufacturing or storage facilities, for testing, inspection, or other purposes, Seller shall inform Buyer in advance of any safety preparations, standards, or programs with which Buyer and its representatives must comply.

ARTICLE 3 — PROCUREMENT CONTRACT DOCUMENTS

3.01 Intent

- A. The Procurement Documents are complementary; what is called for by one is as binding as if called for by all.
- B. Any labor, documentation, services, materials, or equipment that may reasonably be inferred from the Procurement Contract Documents or from prevailing custom or trade usage as being required to produce or furnish the indicated Goods and Special Services will be provided, whether or not specifically called for, at no additional cost to Buyer.
- C. Unless otherwise stated in the Procurement Contract Documents, if there is a discrepancy between the electronic or digital versions of the Procurement Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version will govern.

- D. The Procurement Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Procurement Contract Documents.
- F. Any provision or part of the Procurement 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 Buyer and Seller.

3.02 Reference Standards

- A. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws and Regulations, whether such reference be specific or by implication, means the standard, specification, manual, code, or Laws and Regulations in effect at the time of opening of Bids (or on the Effective Date of the Procurement Agreement if there were no Bids), except as may be otherwise specifically stated in the Procurement Contract Documents.
- B. 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 Buyer, Seller, or Engineer from those set forth in the part of the Procurement Contract Documents prepared by or for Engineer. No such provision or instruction will be effective to assign to Buyer or Engineer any duty or authority to supervise or direct the performance of Seller's obligations, or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Procurement Contract Documents prepared by or for Engineer.

3.03 Reporting and Resolving Discrepancies

- A. Reporting Discrepancies
 - 1. Seller's Review of Procurement Contract Documents: If, before or during the performance of Seller's obligations, Seller discovers any conflict, error, ambiguity, or discrepancy within the Procurement Contract Documents, or between the Procurement 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 to Seller, then Seller shall promptly report it to Engineer (or if the Procurement Contract is assigned, then directly to Contractor/Assignee) in writing. Seller shall not proceed with the Goods and Special Services affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer (or if the Procurement Contract is assigned, then by Contractor/Assignee) or by an amendment or supplement to the Procurement Contract Documents issued pursuant to Article 11.
 - 2. Seller shall not be liable to Buyer or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Procurement Contract Documents unless Seller had actual knowledge thereof.
- B. Resolving Discrepancies: Except as may be otherwise specifically stated in the Procurement Contract Documents, the provisions of the Procurement Contract Documents will take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Procurement Contract Documents and:
 - 1. the provisions of any standard, specification, manual, code, or instruction (whether or not specifically incorporated by reference in the Procurement Contract Documents); or

2. the provisions of any Laws or Regulations applicable to the furnishing of the Goods and Special Services (unless such an interpretation of the provisions of the Procurement Contract Documents would result in violation of such Law or Regulation).

3.04 Requirements of the Procurement Drawings and Procurement Specifications

- A. During the performance of Seller's obligations and until final payment, Seller and Buyer shall submit to the Engineer all matters in question concerning the requirements of the Procurement Drawings and Procurement Specifications (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Goods and Special Services, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Procurement Drawings and Procurement Specifications, and judge of the acceptability of the Goods and Special Services thereunder.
 1. After assignment (if any) Seller shall submit such matters directly to Contractor/Assignee for response or administration, and the Procurement Contract provisions in Paragraphs 3.04.B and C will not apply.
- B. Engineer will issue with reasonable promptness a written clarification, interpretation, or decision on the issue submitted, and if necessary, initiate an amendment or supplement to the Procurement Drawings or Procurement Specifications. Engineer's written clarification, interpretation, or decision will be consistent with the overall intent of the Procurement Contract Documents and will be final and binding on Seller and Buyer. If either Buyer or Seller believes that a written clarification or interpretation justifies an adjustment in the Procurement Contract Price or Procurement Contract Times, either may make a Claim for such adjustment.
- C. If a submitted matter in question concerns terms and conditions of the Procurement Contract Documents that do not involve (1) the performance or acceptability of the Goods and Services, (2) the design (as set forth in the Procurement Drawings, Procurement Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Buyer and Seller that Engineer is unable to provide a decision or interpretation.

3.05 Reuse of Documents

- A. Seller and its subcontractors and suppliers shall not:
 1. have or acquire any title to or ownership rights in any of the Procurement Drawings, Procurement Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Procurement Drawings, Procurement Specifications, other documents, or copies thereof, on extensions of the Project or any other project, without written consent of Buyer and Engineer and specific written verification or adaptation by Engineer; or
 2. have or acquire any title or ownership rights in any other Procurement Contract Documents, reuse any such Procurement Contract Documents for any purpose without Buyer's express written consent, or violate any copyrights pertaining to such Procurement Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Procurement Contract. Nothing herein precludes Seller from retaining copies of the Procurement Contract Documents for record purposes.

ARTICLE 4 — COMMENCEMENT AND SCHEDULE

4.01 Commencement of Procurement Contract Times

- A. The Procurement Contract Times will commence to run on the Effective Date of the Procurement Contract.

4.02 Continuing Performance

- A. Seller shall adhere to the progress schedule established in accordance with Paragraph 2.04.A., as duly adjusted, and the Goods will be delivered, and the Special Services furnished within the Procurement Contract Times.
- B. Seller shall carry on furnishing of the Goods and Special Services and adhere to the progress schedule during all disputes or disagreements with Buyer. No furnishing of Goods and Special Services will be delayed or postponed pending resolution of any disputes or disagreements, except as expressly permitted herein, or as Buyer and Seller may otherwise agree in writing.

4.03 Adjustments to Progress Schedule

- A. The progress schedule may be adjusted from time to time as provided below.
 - 1. Seller shall submit to Buyer for acceptance proposed adjustments in the progress schedule that will not result in changing the Procurement Contract Times. Such adjustments will comply with any applicable provisions of the Procurement Specifications.
 - 2. Proposed adjustments in the progress schedule that will change the Procurement Contract Times must be submitted in accordance with the requirements of Article 11. Adjustments in Procurement Contract Times may only be made by a Change Order.

4.04 Delays

- A. If Buyer, Engineer, or anyone for whom Buyer is responsible, delays, disrupts, or interferes with Seller's performance or progress, then Seller shall be entitled to an equitable adjustment in Procurement Contract Price or Procurement Contract Times.
- B. Seller shall not be entitled to an adjustment in Procurement Contract Price or Procurement Contract Times for delay, disruption, or interference caused by or within the control of Seller or anyone for whom Seller is responsible.
- C. If Seller's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Buyer, Seller, and those for which they are responsible, then Seller shall be entitled to an equitable adjustment in Procurement Contract Times. Such an adjustment will be Seller'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 Procurement 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. inspection delays by governmental authorities, and custom delays;
 - 4. international shipping delays;
 - 5. acts or failures to act of third-party entities; and
 - 6. acts of war or terrorism.

- D. Adjustments of Procurement Contract Times or Procurement Contract Price—
General Provisions: Seller's entitlement to an adjustment of Procurement Contract Times or Procurement Contract Price is limited as follows:
1. Seller's entitlement to an adjustment of the Procurement Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of Seller's obligations, as of the time of the delay, disruption, or interference.
 2. Seller shall not be entitled to an adjustment in Procurement 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 Seller. Such a concurrent delay by Seller does not preclude an adjustment of Procurement Contract Times to which Seller is otherwise entitled.
 3. Adjustments of Procurement Contract Times or Procurement Contract Price are subject to the provisions of Articles 11 and 12.
- E. Each Seller request seeking a delay-related increase in Procurement Contract Times or Procurement 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 Seller's progress; (3) the date upon which each cause of delay, disruption, or interference ceased to affect Seller's progress; (4) the number of days' increase in Procurement Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and (5) the impact on Procurement Contract Price. Seller shall also furnish such additional supporting documentation as Buyer 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.

ARTICLE 5 — BONDS AND INSURANCE

5.01 Performance, Payment, and Other Bonds

- A. Seller shall furnish a performance bond and a payment bond, each in an amount at least equal to the Procurement Contract Price, as security for the faithful performance and payment of Seller's obligations under the Procurement Contract. These bonds must remain in effect until 1 year after the date when final payment becomes due or until completion of the correction period, 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 Procurement Contract.
- B. Seller shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Procurement Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Buyer prior to execution of the Procurement Contract, except as provided otherwise by Laws or 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. Seller 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 Seller is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Seller shall promptly notify Buyer and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements of this Procurement Contract.
- F. If Seller has failed to obtain a required bond, Buyer may exercise Buyer's termination rights.
- G. Upon request to Buyer from any subcontractor, supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of Seller's obligations, Buyer shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Seller from any subcontractor, supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of Seller's obligations, Seller shall provide a copy of the payment bond to such person or entity.

5.02 Insurance

- A. Seller shall provide insurance of the types and coverages and in the amounts stipulated in the Supplementary Conditions.
- B. Failure of Buyer to demand certificates of insurance or other evidence of Seller's full compliance with these insurance requirements or failure of Buyer to identify a deficiency in compliance from the evidence provided will not be construed as a waiver of Seller's obligation to maintain such insurance.
- C. Upon assignment of this Procurement Contract, Seller shall name the Contractor/Assignee as an additional insured and comply with the written request of Contractor/Assignee to provide evidence of insurance.
- D. Buyer does not represent that insurance coverage and limits established in this Procurement Contract necessarily will be adequate to protect Seller.
- E. The insurance and insurance limits required herein will not be deemed as a limitation on Seller's liability under the indemnities and other rights granted to Buyer in the Procurement Contract.

5.03 Surety or Insurance Companies

- A. All bonds and insurance required by the Procurement Contract Documents to be purchased and maintained by Buyer or Seller shall be obtained from surety or insurance companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies must also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

ARTICLE 6 — LICENSES AND FEES

6.01 Intellectual Property and License Fees

- A. Except to the extent stated elsewhere in the Procurement Contract Documents, Seller is not transferring any patent rights, copyrights, or other intellectual property rights for the Goods delivered.
- B. To the extent Seller is manufacturing to Buyer's design, Buyer retains all patent rights, copyrights, and other intellectual property rights in such design.
- C. If an invention, design, process, product, or device is specified in the Procurement Contract Documents for incorporation in the Goods or for the performance of Special Services, and if, to the actual knowledge of Buyer or Engineer, its use is subject to patent rights, copyrights, or other intellectual property rights calling for the payment of a license fee or royalty to others, then the existence of such rights and payment obligations will be disclosed to Seller in the Procurement Contract Documents.
- D. Seller shall pay all license fees and royalties and assume all costs incident to the use or the furnishing of the Goods, unless specified otherwise by the Procurement Contract Documents.

6.02 Seller's Infringement

- A. Subject to Paragraph 6.01, to the fullest extent permitted by Laws and Regulations, Seller shall indemnify and hold harmless Buyer, Engineer, and their officers, directors, members, partners, employees, agents, consultants, contractors, and subcontractors, from and against all claims, costs, losses, damages, and judgments (including, but not limited to, all reasonable 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 or alleged infringement of any patent, copyright, or other intellectual property right by any of the Goods as delivered or Special Services as performed.
- B. Buyer will promptly notify Seller in writing of any claim, suit, or threat of suit by a third party for any infringement or alleged infringement of any patent, copyright, or other intellectual property right with respect to the Goods as delivered or Special Services as performed.
- C. Seller shall promptly defend or settle the claim or suit. Seller shall have control over such claim or suit, bear all expenses, and satisfy any adverse judgment.
 - 1. If Seller fails to defend such suit or claim after written notice by Buyer, Seller will be bound, in any subsequent suit or claim against Seller by Buyer, by any factual determination in the prior suit or claim.
 - 2. If Buyer fails to provide Seller the opportunity to defend such suit or claim, Buyer shall be barred from any remedy against Seller for such suit or claim.
- D. If a determination is made that Seller has infringed upon the intellectual property rights of another, Seller may, at Seller's own expense, obtain the necessary licenses for Buyer's benefit, or replace the Goods and provide related design and construction, consistent with the requirements of the Procurement Contract Documents, to avoid the infringement.

6.03 Buyer's Infringement

- A. Subject to Paragraph 6.01, and to the fullest extent permitted by Laws and Regulations, Buyer shall be responsible to Seller for any infringement or alleged infringement of any patent, copyright, or other intellectual property right caused by Seller's compliance with the Procurement Drawings or Procurement Specifications, and will reimburse Seller for any license fee or royalties paid by Seller to others if such payment resulted from any invention, design, process, product, or device specified to be furnished or performed in the Procurement Drawings or Procurement Specifications, but not identified as being subject to payment of such license fee or royalty.
- B. Seller will promptly notify Buyer in writing of any claim, suit, or threat of suit by a third party for intellectual property infringement arising from Seller's compliance with the Procurement Drawings or Procurement Specifications.
- C. Buyer shall defend or settle the claim or suit. Buyer shall have control over such claim or suit, bear all expenses, and satisfy any adverse judgment.
 - 1. If Buyer fails to defend such suit or claim after written notice by Seller, Buyer will be bound, in any subsequent suit or claim against Buyer by Seller, by any factual determination in the prior suit or claim.
 - 2. If Seller fails to provide Buyer the opportunity to defend such suit or claim, Seller shall be barred from any remedy against Buyer for such suit or claim.

ARTICLE 7 — SELLER'S RESPONSIBILITIES

7.01 Performance of Obligations

- A. Seller shall be solely responsible for the means, methods, techniques, sequences, and procedures necessary to perform its obligations in accordance with the Procurement Contract Documents.
- B. Seller shall supervise, inspect, and direct the furnishing of the Goods and Special Services competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform its obligations in accordance with the Procurement Contract Documents.
- C. Seller shall coordinate the provision of Special Services to avoid or limit interference or disruption of other activities at the location where the Special Services are to occur, including, but not limited to, ongoing facility operations and construction activities.

7.02 Labor, Materials and Equipment

- A. Seller shall provide competent, qualified and trained personnel in all aspects of its performance of the Procurement Contract.
- B. All Goods, and all equipment and material incorporated into the Goods, must be as specified, and unless specified otherwise in the Procurement Contract Documents, must be:
 - 1. new, and of good quality;
 - 2. protected, assembled, connected, cleaned, and conditioned in accordance with the original manufacturer's instructions; and
 - 3. shop-assembled to the greatest extent practicable.

7.03 Laws and Regulations

- A. Seller shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of its obligations in accordance with the Procurement Contract Documents. Except where otherwise expressly required by such Laws and Regulations, neither Buyer nor Engineer shall be responsible for monitoring Seller's compliance with any Laws or Regulations.
- B. If Seller furnishes Goods and Special Services knowing or having reason to know that such furnishing is contrary to Laws or Regulations, Seller shall bear 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 performance. It will not be Seller's responsibility to make certain that the Procurement Specifications and Procurement Drawings are in accordance with Laws and Regulations, but this provision will not relieve Seller of Seller's obligations.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Procurement Contract if there were no Bids) that have a direct effect on the cost or time of Seller's performance will be the subject of an adjustment in Procurement Contract Price or Procurement Contract Times. If Buyer and Seller are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made.

7.04 "Or Equals"

- A. Whenever an item of material or equipment to be incorporated into the Goods is specified or described in the Procurement Contract Documents by using the names of one or more proprietary items or specific suppliers or manufacturers, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, other items of material or equipment or material or equipment of other suppliers or manufacturers may be submitted to Buyer for Engineer's review.
 - 1. If in Engineer's sole discretion, such an item of material or equipment proposed by Seller is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by Engineer as an "or equal" item.
 - 2. For the purposes of this paragraph, a proposed item of material or equipment may be considered functionally equal to an item so named only if in the exercise of reasonable judgment, Engineer determines that: (1) it is at least equal in quality, durability, appearance, strength, and design characteristics; (2) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole; (3) it has an acceptable record of performance and availability of responsive service; and (4) Seller certifies that if approved: (a) there will be no increase in any cost, including capital, installation or operating costs, to Buyer; and (b) the proposed item will conform substantially to the detailed requirements of the item named in the Procurement Contract Documents.
- B. Engineer's Evaluation: Engineer will be allowed a reasonable time within which to evaluate each proposal or Submittal made pursuant to Paragraph 7.04.A. Engineer will be the sole judge of whether to accept or reject such a proposal or Submittal. No "or equal" will be ordered, manufactured or utilized until Engineer's review is

complete, which will be evidenced by an approved Shop Drawing. Engineer will advise Buyer and Seller in writing of any negative determination. Notwithstanding Engineer's approval of an "or-equal" item, Seller shall remain obligated to comply with the requirements of the Procurement Contract Documents.

- C. Special Guarantee: Buyer may require Seller to furnish at Seller's expense a special performance guarantee or other surety with respect to any such proposed "or equal."
- D. Data: Seller shall provide all data in support of any such proposed "or equal" at Seller's expense.

7.05 Taxes

- A. Seller shall pay all taxes and duties arising out of the sale of the Goods and the performance of Special Services. All taxes and duties are included in the Procurement Contract Price, except as noted in the Supplementary Conditions.

7.06 Submittals

- A. Shop Drawing and Sample Requirements
 - 1. Before submitting a Shop Drawing or Sample, Seller shall:
 - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Procurement 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; and
 - 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 Seller's obligations.
 - 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 Seller has satisfied its obligations under the Procurement Contract Documents with respect to Seller's review of that Submittal, and that Seller approves the Submittal.
 - 3. With each Shop Drawing or Sample, Seller shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Procurement Contract Documents. This notice will 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: Seller 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. Seller shall submit the number of copies required in the Procurement 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 Seller proposes to provide, and to enable Engineer to review the information for the limited purposes required.

2. Samples

- a. Seller shall submit the number of Samples required in the Procurement Specifications.
- b. Seller 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.

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

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 Goods, comply with the requirements of the Procurement Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Procurement Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, manufacturing, fabrication, installation, or shipping, 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 Seller from responsibility for any variation from the requirements of the Procurement Contract Documents unless Seller has complied with the requirements of Paragraph 7.06.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 document any such approved variation from the requirements of the Procurement Contract Documents in a Field Order or other appropriate Procurement Contract modification.
5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Seller from responsibility for complying with the requirements.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Procurement Contract Documents, will not, under any circumstances, change the Procurement Contract Times or Procurement 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 Procurement Contract Document.
8. Seller shall furnish Goods that comply with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.06.C.4.

D. Resubmittal Procedures for Shop Drawings and Samples

1. Seller 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. Seller shall direct specific attention in writing

- to revisions other than the corrections called for by Engineer on previous Submittals.
2. Seller 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 Seller shall be responsible for Engineer's charges to Buyer for such time. Buyer may impose a set-off against payments due Seller to secure reimbursement for such charges.
 3. If Seller requests a change of a previously approved Shop Drawing or Sample, Seller shall be responsible for Engineer's charges to Buyer for its review time, and Buyer may impose a set-off against payments due Seller to secure reimbursement for such charges, unless the need for such change is beyond the control of Seller.
- E. Submittals Other than Shop Drawings and Samples
1. The following provisions apply to all Submittals other than Shop Drawings and Samples:
 - a. Seller shall submit all such Submittals to the Engineer in accordance with the schedule of Submittals and pursuant to the applicable terms of the Procurement 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 Procurement Contract Documents as to general form and content of the Submittal.
 - d. If any such Submittal is not accepted, Seller 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 2.04 and 2.05.

7.07 Indemnification

- A. To the fullest extent permitted by Laws and Regulations, Seller shall indemnify and hold harmless Buyer, Engineer, Project Owner, and any assignee of Buyer, including Contractor/Assignee, and their officers, directors, members, partners, employees, agents, consultants, contractors, 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 the performance of Seller's obligations under the Procurement Contract, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Goods themselves), including the loss of use resulting therefrom, but only to the extent caused by any negligent act or omission of Seller, or any individual or entity directly or indirectly employed by Seller or anyone for whose acts Seller may be liable.

- B. In any and all claims against Buyer, Engineer, Project Owner, or any assignee of Buyer, including Contractor/Assignee, or their officers, directors, members, partners, employees, agents, consultants, contractors, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Seller, any subcontractor, any supplier, or any individual or entity directly or indirectly employed by any of them to furnish any of the Goods and Special Services, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.07.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 Seller or any such subcontractor, supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.08 Concerning Subcontractors and Suppliers

- A. Seller may retain subcontractors and suppliers for the performance of parts of the furnishing of the Goods and Special Services. The Seller's retention of a subcontractor or supplier will not relieve Seller's obligation to Buyer to perform and complete the furnishing of the Goods and Special Services in accordance with the Procurement Contract Documents.

ARTICLE 8 — SHIPPING AND DELIVERY

8.01 Shipping

- A. Seller shall select the carrier and bear all costs of packaging, transportation, insurance, special handling, and all other costs associated with shipment and delivery.

8.02 Delivery

- A. Seller shall deliver the Goods free on board (FOB) to the Point of Destination, freight prepaid, in accordance with the Procurement Contract Times set forth in the Procurement Agreement, or other date agreed to by Buyer and Seller.
- B. At least 10 days before shipment, Seller shall provide written notice to Buyer of the manner of shipment and the anticipated delivery date. The notice must also include any instructions concerning special equipment or services required at the Point of Destination to unload and care for the Goods. Seller shall also require the carrier to give Buyer at least 24 hours' notice by telephone prior to the anticipated time of delivery.
- C. Buyer will be responsible and bear all costs for unloading the Goods from carrier.
- D. Buyer will assure that adequate facilities are available to receive delivery of the Goods at the time established for delivery, or on another date agreed to by Buyer and Seller.
- E. No partial deliveries will be allowed, unless permitted or required by the Procurement Contract Documents or agreed to in writing by Buyer.
- F. Provisions governing inspection on delivery are set forth in Paragraph 9.02.

8.03 Risk of Loss

- A. Risk of loss and insurable interests transfer from Seller to Buyer upon Buyer's receipt of the Goods.

- B. Notwithstanding the provisions of Paragraph 8.03.A, if Buyer rejects the Goods as non-conforming, the risk of loss on such Goods will remain with Seller until Seller corrects the non-conformity or Buyer accepts the Goods. If rejected Goods remain at the Point of Destination pending modification and acceptance, then Seller shall be responsible for arranging adequate protection and maintenance of the Goods at Seller's expense.

ARTICLE 9 — BUYER'S RIGHTS

9.01 Seller's Warranties and Guarantees

- A. Seller warrants and guarantees to Buyer that the title to the Goods conveyed will be proper, its transfer rightful, and free from any security interest, lien, or other encumbrance. Seller shall defend, indemnify, and hold Buyer harmless against any liens, claims, or demands contesting or affecting title of the Goods conveyed.
- B. Seller warrants and guarantees to Buyer that all Goods and Special Services will conform with the Procurement Contract Documents, and with the standards established by any Samples approved by Engineer. Engineer shall be entitled to rely on Seller's warranty and guarantee. If the Procurement Contract Documents do not otherwise specify the characteristics or the quality of the Goods, the Goods must comply with the requirements of Paragraph 7.02.B.
- C. Seller's warranty and guarantee hereunder excludes defects or damage caused by:
 - 1. abuse, improper modification, improper maintenance, or improper operation by persons other than Seller;
 - 2. excessive corrosion or chemical attack, unless corrosive or chemically damaging conditions were disclosed by Buyer in the Procurement Contract Documents and the Procurement Contract Documents required the Goods to withstand such conditions;
 - 3. use in a manner contrary to Seller's written instructions for installation, operation, and maintenance; or
 - 4. normal wear and tear under normal usage.
- D. Seller's obligation to furnish the Goods and Special Services in accordance with the Procurement Contract Documents will be absolute. None of the following will constitute an acceptance of Goods and Special Services that are non-conforming, or a release of Seller's obligation to furnish the Goods and Special Services in accordance with the Procurement Contract Documents:
 - 1. observations by Buyer, Engineer, or Project Owner;
 - 2. recommendation by Engineer or payment by Buyer of any progress or final payment;
 - 3. use of the Goods by Buyer or Project Owner;
 - 4. any acceptance by Buyer, Engineer, or Project Owner, or any failure to do so;
 - 5. the end of the correction period established in Paragraph 9.04;
 - 6. the issuance of a notice of acceptance;
 - 7. any inspection, test or approval by others; or
 - 8. any correction of non-conforming Goods and Special Services by Buyer or Project Owner.
- E. Buyer shall promptly notify Seller of any breach of Seller's warranties or guarantees.

9.02 Inspections and Testing

A. General Provisions

1. The Procurement Contract Documents specify required inspections and tests. Buyer shall have the right to perform, or cause to be performed, reasonable inspections and require reasonable tests of the Goods at Seller's facility, and at the Point of Destination. Seller shall allow Buyer a reasonable time to perform such inspections or tests.
 2. Seller shall reimburse Buyer for all expenses, except for travel, lodging, and subsistence expenses of Buyer's and Engineer's representatives, for inspections and tests specified in the Procurement Contract Documents. If as the result of any such specified testing the Goods are determined to be non-conforming, then Seller shall also bear the travel, lodging, and subsistence expenses of Buyer's and Engineer's representatives, and all expenses of re-inspection or retesting.
 3. Buyer shall bear all expenses of inspections and tests that are not specified in the Procurement Contract Documents (other than any re-inspection or retesting resulting from a determination of non-conformity, as set forth in Paragraph 9.03); provided, however, that if as the result of any such non-specified inspections or testing the Goods are determined to be non-conforming, then Seller shall bear all expenses of such inspections and testing, and of any necessary re-inspection and retesting.
 4. Seller shall provide Buyer timely written notice of the readiness of the Goods for all inspections, tests, or approvals which the Procurement Contract Documents specify are to be observed by Buyer prior to shipment.
 5. Buyer will give Seller timely notice of all specified tests, inspections, and approvals of the Goods which are to be conducted at the Point of Destination, and a representative of Seller will attend such tests, inspections, and approvals.
 6. If, on the basis of inspections or testing, the Goods appear to be conforming, Buyer will give Seller prompt notice thereof. If on the basis of inspections or testing, the Goods appear to be non-conforming, Buyer will give Seller prompt notice thereof and will advise Seller of the remedy Buyer elects under the provisions of Paragraph 9.03.
 7. Neither payments made by Buyer to Seller prior to any tests or inspections, nor any tests or inspections, will constitute acceptance of non-conforming Goods, or prejudice Buyer's rights under the Procurement Contract.
- B. Visual Inspection on Delivery
1. Buyer will visually inspect the Goods upon delivery solely for purposes of identifying the Goods, general verification of quantities, and observation of apparent condition. Such visual inspection will not be construed as final or as receipt of any Goods and Special Services that, as a result of subsequent inspections and tests, are determined to be non-conforming.
 2. If, on the basis of the visual inspection specified in this Document, the Goods appear to comply with the requirements of the Procurement Contract Documents as to quantities and condition, then within 10 days of delivery Buyer shall issue to Seller Buyer's acknowledgment of the receipt of Goods.
- C. Final Inspection
1. After all of the Goods have been incorporated into the Project, tested in accordance with such testing requirements as are specified, and are functioning as required, and Seller has performed and completed all Special Services, Buyer will make a final inspection.
 2. If, on the basis of the final inspection, Buyer determines that the Goods and Special Services are conforming, Buyer's notice thereof will constitute Buyer's

acceptance of the Goods and Special Services, subject to any limitations stated in the notice.

3. If, on the basis of the final inspection, the Goods and Special Services are non-conforming, Buyer will identify the non-conformity in writing.

9.03 Non-Conforming Goods and Special Services

- A. If, on the basis of inspections and testing prior to delivery, the Goods and Special Services are found to be non-conforming, or if at any time after Buyer has acknowledged receipt of delivery and before the expiration of the correction period described in this Document, Buyer determines that the Goods and Special Services are non-conforming, then Seller shall promptly, without cost to Buyer and in response to written instructions from Buyer, either correct such non-conforming Goods and Special Services, or, if Goods are rejected by Buyer, remove and replace the non-conforming Goods with conforming Goods, including all work required for reinstallation.
- B. Buyer's Rejection of Non-Conforming Goods
 1. If Buyer elects to reject the Goods in whole or in part, Buyer's notice to Seller will describe in sufficient detail the non-conforming aspect of the Goods. If Goods have been delivered to Buyer, Seller shall promptly, and within the Procurement Contract Times, remove and replace the rejected Goods.
 2. Seller shall bear all costs, losses and damages attributable to the removal, replacement, reinspection, and retesting of the non-conforming Goods.
 3. Upon rejection of the Goods, Buyer retains a security interest in the Goods to the extent of any payments made and expenses incurred in their testing and inspection.
- C. Buyer's Rejection of Non-Conforming Special Services
 1. If at any time Buyer elects to reject the Special Services in whole or in part, Buyer's notice to Seller will describe in sufficient detail the non-conforming aspect of the Special Services.
 2. Seller shall promptly provide conforming Special Services acceptable to Buyer.
 3. If Seller fails to provide conforming Special Services, Buyer may remove the Special Services from the scope of the Procurement Contract, and equitably reduce the Procurement Contract Price.
- D. Remedying Non-Conforming Goods: If Buyer elects to permit the Seller to modify the Goods to correct the non-conformance, then Seller shall promptly provide a schedule for such modifications and shall make the Goods conforming within a reasonable time.
- E. Buyer's Acceptance of Non-Conforming Goods: Instead of requiring correction or removal and replacement of non-conforming Goods discovered either before or after final payment, Buyer may accept the non-conforming Goods. Seller shall bear all reasonable costs, losses, and damages attributable to Buyer's evaluation of and determination to accept such non-conforming Goods.
- F. Seller Obligations: Seller shall pay all claims, costs, losses, and damages, including, but not limited to, all fees and charges for re-inspection, retesting and for any engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs arising out of or relating to the non-conforming Goods and Special Services. Seller's obligations will include the costs of the correction or removal and replacement of the non-conforming Goods and the

replacement of property of Buyer and others destroyed by the correction or removal and replacement of the non-conforming Goods and obtaining conforming Special Services from others.

- G. Buyer's Rejection of Conforming Goods: If Buyer asserts that Goods and Special Services are non-conforming and such Goods and Special Services are determined to be conforming, or if Buyer rejects as non-conforming Goods and Special Services that are later determined to be conforming, then Seller shall be entitled to reimbursement from Buyer of costs incurred by Seller in inspecting, testing, correcting, removing, or replacing the conforming Goods and Special Services, including, but not limited to, fees and charges of engineers, architects, attorneys and other professionals, and all court or arbitration or other dispute resolution costs associated with the incorrect assertion of non-conformance or rejection of conforming Goods and Special Services.

9.04 Correction Period

- A. Seller's responsibility for correcting all non-conformities in the Goods and Special Services will extend for a period of 1 year after the acceptance of the Goods and Special Services.
- B. Where non-conforming Goods and Services (and damage to other work resulting therefrom) have been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Goods and Services will be extended for an additional period of 1 year after such correction or removal and replacement has been satisfactorily completed.
- C. Seller's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph may not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 10 — ENGINEER'S STATUS

10.01 Engineer's Role Defined

- A. Engineer will be Buyer's representative until assignment (if any) of the Procurement Contract.
- B. The duties and responsibilities and the limitations of authority of Engineer prior to assignment, if any, of the Procurement Contract, are set forth in the Procurement Contract Documents.
- C. Engineer's responsibilities, if any, after an assignment (if any) of the Procurement Contract, are set forth in the Procurement Agreement.

10.02 Duties and Responsibilities; Authority; Limitations

- A. Engineer will be the initial interpreter of the Procurement Contract Documents and judge of the acceptability of the Goods and Special Services, and will issue clarifications, interpretations, and decisions regarding such issues.
- B. Acting on behalf of Buyer under the provisions of Article 9, Engineer has the authority to disapprove or reject Goods and Special Services that Engineer believes to be non-conforming. Engineer also has the authority to require special inspection or testing of the Goods or Special Services, whether or not the Goods are fabricated or installed, or the Special Services are completed.

- C. Engineer may authorize minor deviations or variations in the Procurement Contract Documents by: (1) written approval of specific variations set forth in Shop Drawings when Seller has duly noted such variations, or (2) a Field Order.
- D. Engineer will review Claims, and render decisions on Claims.
- E. In rendering any interpretations, clarifications, reviews, decisions, disapprovals, acceptances, rejections, authorizations, and judgments, Engineer will not show partiality to Buyer or Seller. Engineer will not be liable to Buyer, Seller, or others in connection with any interpretations, clarifications, reviews, decisions, disapprovals, acceptances, rejections, authorizations, or judgments conducted or rendered by Engineer in good faith.
- F. Engineer will not supervise, direct, control, or have authority over or be responsible for the means, methods, techniques, sequences, or procedures used by Seller to perform its obligations under this Procurement Contract, or the safety precautions and programs incident thereto, or for any failure of Seller to comply with Laws and Regulations applicable to the performance of its obligations. Engineer will not be responsible for Seller's failure to furnish the Goods and Special Services in accordance with the Procurement Contract Documents.

ARTICLE 11 — CHANGES

11.01 Amending and Supplementing the Procurement Contract

- A. The Procurement Contract may be amended or supplemented by a Change Order, a Change Directive, or a Field Order.
- B. If an amendment or supplement to the Procurement Contract includes a change in the Procurement Contract Price or the Procurement Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Procurement Contract that involve (1) the conformance or acceptability of the Goods and Special Services, (2) the design (as set forth in the Procurement Drawings, Procurement Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Buyer and Seller may amend other terms and conditions of the Procurement Contract without the recommendation of the Engineer.

11.02 Change Orders

- A. Buyer and Seller shall execute appropriate Change Orders covering:
 - 1. Changes in Procurement Contract Price or Procurement Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Goods and Special Services furnished in accordance with a Change Directive;
 - 2. Changes in Procurement Contract Price resulting from a Buyer set-off, unless Seller has duly contested such set-off;
 - 3. Changes in the Goods and Special Services which are: (a) ordered by Buyer pursuant to Paragraph 11.05, (b) required because of Buyer's acceptance of non-conforming Goods and Services or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Goods and Special Services involves the design (as set forth in the Procurement Drawings, Procurement 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 Change Directive; Article 12, Claims; and similar provisions.
- B. If Buyer or Seller 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 Change Directives

- A. A Change Directive will not change the Procurement Contract Price or the Procurement Contract Times but is evidence that the parties expect that the modification ordered or documented by a Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Change Directive's effect, if any, on the Procurement Contract Price and Procurement Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Procurement Contract Documents governing adjustments, expressly including Paragraph 11.08 regarding change of Procurement Contract Price.
- B. If Buyer has issued a Change Directive and Buyer or Seller believes that an adjustment in Procurement Contract Times or Procurement Contract Price is necessary, then such party shall submit a Claim seeking such an adjustment no later than 30 days after the completion of the Goods and Services set out in the Change Directive.

11.04 Field Orders

- A. Engineer may authorize minor changes in the Goods and Services if the changes do not involve an adjustment in the Procurement Contract Price or the Procurement Contract Times and are compatible with the design concept as indicated by the Procurement Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Buyer and also on Seller, which shall perform the Goods and Special Services involved promptly.
- B. If Seller believes that a Field Order justifies an adjustment in the Procurement Contract Price or Procurement Contract Times, then before proceeding with the Goods and Special Services at issue, Seller shall submit a Claim as provided in this Document.

11.05 Buyer-Authorized Changes in the Goods and Special Services

- A. Without invalidating the Procurement Contract and without notice to any surety, Buyer may, at any time or from time to time, order additions, deletions, or revisions in the Goods and Special Services. Changes involving the design (as set forth in the Procurement Drawings, Procurement Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Goods and Special Services may be accomplished by a Change Order, if Buyer and Seller have agreed as to the effect, if any, of the changes on Procurement Contract Times or Procurement Contract Price; or by a Change Directive. Upon receipt of any such document, Seller shall promptly proceed with the Goods and Special Services involved; or, in the case of a deletion in the Goods and Special Services, promptly cease activities with respect to such deletion. Added or revised Goods and Special Services must be performed under the applicable conditions of the Procurement Contract Documents.

11.06 Buyer's Contingency Allowance

- A. The Buyer's Contingency Allowance, if any such is set forth in the Procurement Agreement, is for the sole use of Buyer to cover unanticipated costs.
- B. If Buyer exercises its unilateral right to use all or a portion of the Buyer's Contingency Allowance, Buyer will issue a written directive that documents the costs to which the allowance is applied, Seller's entitlement to compensation, and the consequent reduction in such allowance.
- C. Prior to final payment, the Total Price, as set forth in the Procurement Agreement, will be duly adjusted to account for any unused portion of the Buyer's Contingency Allowance.
- D. The Procurement Agreement addresses the impact on Buyer's Contingency Allowance of an assignment of the Procurement Contract.

11.07 Unauthorized Changes in the Goods and Special Services

- A. Seller shall not be entitled to an increase in the Procurement Contract Price or an extension of the Procurement Contract Times with respect to any work performed that is not required by the Procurement Contract Documents, as amended, modified, or supplemented.

11.08 Change of Procurement Contract Price

- A. The Procurement Contract Price may only be changed by a Change Order. Any Claim for an adjustment of Procurement Contract Price must comply with the provisions of Article 12.
- B. An adjustment in the Procurement Contract Price will be determined as follows:
 - 1. For changes in Unit Price Goods and Special Services, by application of the unit prices to the quantities of the items involved;
 - 2. To the extent the cost of the change is not covered by unit prices, then by a mutually agreed lump sum; or
 - 3. To the extent the cost of the change is not covered by unit prices and the parties do not reach mutual agreement to a lump sum, then on the basis of documented costs plus a Seller's fee for overhead and profit of 15 percent.

11.09 Change of Procurement Contract Times

- A. The Procurement Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Procurement Contract Times must comply with the provisions of Article 12.

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 Goods and Special Services or the provisions of the Procurement Contract (including, but not limited to, Procurement Contract Price or Procurement Contract Times), the giving of any such notice will be Seller's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 — CLAIMS, DISPUTES, AND DISPUTE RESOLUTION

12.01 Claims

- A. The parties agree to endeavor to avoid or resolve Claims through direct, good faith discussions and negotiations whenever practicable. Such discussions and negotiations should at the outset address whether the parties mutually agree to suspend the Claims process, including the time periods established in this Document; if so, a written record of such mutual agreement should be made and jointly executed.
- B. Claimant shall deliver to Engineer and the other party to the Procurement Contract written notice of each Claim within 15 days after the occurrence of the event giving rise to the Claim.
- C. Claimant shall deliver written supporting data to Engineer and the other party within 45 days after such occurrence unless Engineer allows an additional period of time.
- D. Engineer will review each such Claim and render a decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.
- E. If Engineer does not render a formal written decision on a Claim within the time stated in this Document, Engineer shall be deemed to have issued a decision denying the Claim in its entirety 31 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any.
- F. The rendering of a decision by Engineer pursuant to this Paragraph 12.01 with respect to any such Claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment) will be a condition precedent to any exercise by Buyer or Seller of such rights or remedies as either may otherwise have under the Procurement Contract Documents or by Laws or Regulations in respect of any such Claim, dispute, or other matter. If the exercise of such rights or remedies will imminently be time-barred, a party may take actions necessary to preserve such rights and remedies notwithstanding the lack of the condition precedent referred to in this paragraph.
- G. If a submitted matter in question concerns terms and conditions of the Procurement Contract Documents that do not involve (1) the performance or acceptability of Goods and Special Services under the Procurement Contract Documents, (2) the design (as set forth in the Procurement Drawings, Procurement Specifications, Addenda, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Buyer and Seller that Engineer is unable to provide a decision or interpretation. If Buyer and Seller are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in this Document.
- H. Engineer's written decision on such Claim or a decision denying the Claim in its entirety that is deemed to have been issued pursuant to Paragraph 12.01, will be final and binding upon Buyer and Seller 30 days after it is issued unless within 30 days of issuance Buyer or Seller appeals Engineer's decision by initiating the mediation of such Claim in accordance with the dispute resolution procedures set forth in this Document.
- I. If Article 12 has been amended to delete the mediation requirement, then Buyer or Seller may appeal Engineer's decision within 30 days of issuance by following the

alternative dispute resolution process set forth in this Document, as amended; or if no such alternative dispute resolution process has been set forth, Buyer or Seller may appeal Engineer's decision by (1) delivering to the other party within 30 days of the date of such decision a written notice of intent to submit the Claim to a court of competent jurisdiction, and (2) within 60 days after the date of such decision instituting a formal proceeding in a court of competent jurisdiction.

- J. No Claim for an adjustment in Procurement Contract Price or Procurement Contract Times will be valid if not submitted in accordance with Article 12.
- K. The effect on Claims of an assignment of the Procurement Contract by Buyer to a Contractor/Assignee is addressed in the Procurement Agreement.

12.02 Dispute Resolution Method

- A. Either Buyer or Seller may initiate the mediation of (1) any Claim decided in writing by Engineer under Paragraph 12.01 before such decision becomes final and binding, or (2) any other dispute between the parties, including, but not limited to, any dispute arising after final inspection of the Goods and Services. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Procurement Contract. The request for mediation must be submitted in writing to the American Arbitration Association and the other party to the Procurement Contract. Timely submission of the request will stay Engineer's decision from becoming final and binding.
- B. Mediation is a condition precedent to seeking final dispute resolution. Buyer and Seller shall participate in the mediation process in good faith. The process must be concluded within 60 days of filing of the request. The date of termination of the mediation will be determined by application of the mediation rules referenced above.
- C. If the mediation process does not result in resolution of the dispute, then Engineer's written Claim decision under Paragraph 12.01.D or a Claim denial pursuant to Paragraph 12.01.E becomes final and binding, or if applicable such other dispute is deemed resolved in favor of respondent, unless, within 30 days after termination of the mediation, Buyer or Seller:
 - 1. elects in writing to invoke any final dispute resolution process provided for in the Supplementary Conditions, or
 - 2. agrees with the other party to submit the Claim or dispute to another final dispute resolution process, or
 - 3. if no final dispute resolution process has been provided for in the Supplementary Conditions, delivers to the other party written notice of the intent to submit the Claim or dispute to a court of competent jurisdiction, and within 60 days of the termination of the mediation institutes such formal proceeding.

ARTICLE 13 — PAYMENT

13.01 Applications for Progress Payments

- A. Seller shall submit to Buyer for Engineer's review Applications for Payment filled out and signed by Seller and accompanied by such supporting documentation as is required by the Procurement Contract Documents and also as Buyer or Engineer may reasonably require.
- B. The timing and amounts of progress payments will be as stipulated in the Procurement Agreement.

- C. Any Application for Payment that is based in whole or in part on the delivery of Goods must be accompanied by a bill of sale, invoice, or other documentation reasonably satisfactory to Buyer warranting that Buyer has rightfully received good title to the Goods from Seller and that, upon payment, the Goods will be free and clear of all liens. Such documentation will include releases and waivers from all parties with viable lien rights.
- D. Buyer shall notify Seller promptly of any deficiency in the required documentation.

13.02 Review of Applications for Progress Payments

A. 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 Buyer, or return the Application to Seller indicating in writing Engineer's reasons for refusing to recommend payment.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Buyer, based on Engineer's observations of Seller's progress, as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Goods and Special Services or other obligations of Seller have progressed to the point indicated;
 - b. the quality of the Goods and Special Services or other obligations of Seller are generally in accordance with the Procurement Contract Documents; and
 - c. the conditions precedent to Seller being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Seller's progress.
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 Goods and Special Services or other obligations of Seller have been exhaustive, extended to every aspect of the Goods and Special Services or other obligations of Seller in progress, or involved detailed inspections of the Goods and Special Services or other obligations of Seller beyond the responsibilities specifically assigned to Engineer in the Procurement Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Seller to be paid additionally by Buyer or entitle Buyer to withhold payment to Seller.
4. Neither Engineer's review of Seller's progress 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 Seller's performance or furnishing of Goods and Special Services or other obligations of Seller; or
 - b. for the means, methods, techniques, sequences, or procedures of construction, manufacturing, fabrication, installation, or shipping, or the safety precautions and programs incident thereto; or
 - c. for Seller's failure to comply with Laws and Regulations applicable to Seller's performance under the Procurement Contract; or

- d. to make any examination to ascertain how or for what purposes Seller has used the money paid for the Procurement Contract Price; or
 - e. to determine that title to any of the Goods or component parts have passed to Buyer 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 Buyer stated in Paragraph 13.02.A.2.
 6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Buyer from loss because:
 - a. the Goods and Services are non-conforming, requiring correction or replacement;
 - b. the Procurement Contract Price has been reduced by Change Orders;
 - c. Buyer has been required to correct non-conforming Goods and Special Services in accordance with Paragraph 9.03.C, or has accepted non-conforming Goods and Special Services pursuant to Paragraph 9.03.E; or
 - d. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Seller and therefore justify termination for cause under the Procurement Contract Documents.

13.03 Basis and Amount of Progress Payments

- A. The basis and amounts of the progress payments will be as provided in the Procurement Agreement, subject to the provisions of this Article 13 regarding reductions in payment.

13.04 Suspension of or Reduction in Payment

- A. Buyer may temporarily cease making progress payments, or reduce the amount of a progress payment, even though recommended for payment by Engineer, under the following circumstances:
 1. Buyer has reasonable grounds to conclude that Seller will not furnish the Goods or the Special Services in accordance with the Procurement Contract Documents, and
 2. Buyer has requested in writing assurances from Seller that the Goods and Special Services will be delivered or furnished in accordance with the Procurement Contract Documents, and Seller has failed to provide adequate assurances within ten days of Buyer's written request.
 3. In addition to any reductions in payment (set-offs) recommended by Engineer, Buyer is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Buyer based on Seller's conduct in the performance or furnishing of the Goods and Special Services, or has incurred costs, losses, or damages resulting from Seller's conduct in the performance or furnishing of the Goods and Special Services, 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;
 - b. Seller has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Point of Destination or the worksite;
 - c. Seller has failed to provide and maintain required bonds or insurance;

- d. Buyer 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;
 - e. the Goods and Special Services are non-conforming, requiring correction or replacement;
 - f. Buyer has been required to correct non-conforming Goods and Special Services, in accordance with Paragraph 9.03.C, or has accepted non-conforming Goods and Special Services pursuant to Paragraph 9.03.E;
 - g. the Procurement Contract Price has been reduced by Change Orders;
 - h. an event that would constitute a default by Seller and therefore justify a termination for cause has occurred;
 - i. liquidated or other damages have accrued as a result of Seller's failure to achieve Milestones, Substantial Completion, or final completion of the Goods and Special Services; or
 - j. liens have been filed in connection with the Procurement Contract, except where Seller has delivered a specific bond satisfactory to Buyer to secure the satisfaction and discharge of such liens.
- B. If Buyer refuses to make payment of the full amount recommended by Engineer, Buyer will provide Seller and Engineer immediate written notice stating the reason for such action and promptly pay Seller any amount remaining after deduction of the amount withheld. Buyer shall promptly pay Seller the amount withheld when Seller corrects the reason for such action to Buyer's satisfaction.

13.05 Final Payment

- A. After Seller has corrected all non-conformities to the reasonable satisfaction of Buyer and Engineer and furnished all Special Services, Seller may submit its final Application for Payment following the procedures for progress payments.
- B. The final Application for Payment will be accompanied by all documentation called for in the Procurement Contract Documents (including, but not limited to, all final operations and maintenance manuals, and any special warranties), a list of all unsettled Claims, and the written consent of surety to the making of final payment.
- C. If, on the basis of final inspection and the review of the final Application for Payment and accompanying documentation, Engineer is reasonably satisfied that Seller has furnished the Goods and Special Services in accordance with the Procurement Contract Documents, and that Seller has fulfilled all other obligations under the Procurement Contract Documents, then Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment subject to the provisions of Paragraph 13.02, and present the final Application for Payment to Buyer. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Buyer from loss for the reasons stated in Paragraph 13.02.
- D. If Engineer does not recommend final payment, Engineer will return the final Application for Payment to Seller, indicating the reasons for refusing to recommend final payment, in which case Seller shall make the necessary corrections and resubmit the final Application for Payment.
- E. In support of its recommendation of final payment Engineer will also give written notice to Buyer and Seller that the Goods and Special Services are acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 13.06.

- F. If the final Application for Payment and accompanying documentation are appropriate as to form and substance, Buyer shall, within 30 days after receipt thereof, pay Seller the amount recommended by Engineer, less any sum Buyer is entitled to set off against Engineer's recommendation, pursuant to the provisions of Paragraph 13.04.
- G. Buyer will not make final payment, or return or release included retainage (if any) at any time, unless Seller submits written consent of the surety to such payment, return, or release.

13.06 Waiver of Claims

- A. By making final payment, Buyer waives its claim or right to liquidated damages or other damages for late completion by Seller, except as set forth in an outstanding Claim, appeal, set-off, or express reservation of rights by Buyer. Buyer reserves all other claims or rights after final payment.
- B. The acceptance of final payment by Seller will constitute a waiver by Seller of all claims and rights against Buyer other than those pending matters that have been duly submitted or appealed under the provisions of Article 12.

ARTICLE 14 — CANCELLATION, SUSPENSION, AND TERMINATION

14.01 Cancellation

- A. Buyer has the right to cancel the Procurement Contract, without cause, at any time prior to delivery of the Goods by written notice. Cancellation pursuant to the terms of this paragraph will not constitute a breach of contract by Buyer. Upon cancellation:
 - 1. Buyer shall pay Seller for the direct costs incurred in producing any Goods that Seller has specially manufactured for the Project, plus a fair and reasonable amount for overhead and profit.
 - 2. For Goods that are not specially manufactured for the Project, Seller shall be entitled to a restocking charge of 10 percent of the unpaid Procurement Contract Price of such Goods.

14.02 Suspension of Performance by Buyer

- A. Buyer has the right to suspend performance of the Procurement Contract for up to 90 days, without cause, by written notice. Upon suspension under this paragraph, Seller shall be entitled to an increase in the Procurement Contract Times and Procurement Contract Price caused by the suspension, provided that performance would not have been suspended or delayed for causes attributable to Seller.

14.03 Suspension of Performance by Seller

- A. Seller may suspend the furnishing of the Goods and Special Services only under the following circumstance:
 - 1. Seller has reasonable grounds to conclude that Buyer will not perform its future payment obligations under the Procurement Contract; and
 - 2. Seller has requested in writing assurances from Buyer that future payments will be made in accordance with the Procurement Contract, and Buyer has failed to provide such assurances within ten days of Seller's written request.

14.04 Breach and Termination

- A. Buyer's Breach

1. Seller shall have the right to terminate the Procurement Contract for cause by declaring a breach if Buyer fails to comply with any material provision of the Procurement Contract. Upon termination, Seller shall be entitled to all remedies provided by Laws and Regulations.
 2. If Seller believes Buyer is in breach of its obligations under the Procurement Contract, Seller shall provide Buyer with reasonably prompt written notice setting forth in sufficient detail the reasons for declaring that it believes a breach has occurred. Buyer shall have 7 days from receipt of the written notice declaring the breach (or such longer period of time as Seller may grant in writing) within which to cure or to proceed diligently to cure such alleged breach.
- B. Seller's Breach
1. Buyer may terminate Seller's right to perform the Procurement Contract for cause by declaring a breach should Seller fail to comply with any material provision of the Procurement Contract Documents. Upon termination, Buyer shall be entitled to all remedies provided by Laws and Regulations.
 2. In the event Buyer believes Seller is in breach of its obligations under the Procurement Contract, Buyer shall provide Seller with reasonably prompt written notice setting forth in sufficient detail the reasons for declaring that it believes a breach has occurred. Seller shall have 7 days from receipt of the written notice declaring the breach (or such longer period of time as Buyer may grant in writing) within which to cure or to proceed diligently to cure such alleged breach.
 3. If and to the extent that Seller has provided a performance bond under the provisions of Paragraph 5.01, the notice and cure procedures of that bond, if any, will supersede the notice and cure procedures of Paragraph 14.04.B.2.

ARTICLE 15 — MISCELLANEOUS

15.01 Giving Notice

- A. Whenever any provision of the Procurement Documents requires the giving of written notice to Buyer, Seller, or Engineer, it will be deemed to have been validly given 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.

15.02 Controlling Law

- A. This Procurement Contract is to be governed by the law of the state in which the Goods are to be installed.
- B. In the case of any conflict between the express terms of this Procurement Contract and the Uniform Commercial Code, as adopted in the state whose law governs, it is the intent of the parties that the express terms of this Procurement Contract will apply.

15.03 Computation of Time

- A. When any period of time is referred to in the Procurement Documents by number of 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. When any period of time is referred to in the Procurement Documents by number of 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.

15.04 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 Procurement Contract, and the provisions of this paragraph will be as effective as if repeated specifically in the Procurement Contract in connection with each particular duty, obligation, right, and remedy to which they apply.

15.05 Survival of Obligations

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Procurement Contract, as well as all continuing obligations indicated in the Procurement Contract, will survive final payment, completion, and acceptance of the Goods and Special Services or termination or completion of the Procurement Contract or of the services of Seller.

15.06 Entire Agreement

- A. Buyer and Seller agree that this Procurement Contract is the complete and final agreement between them, and supersedes all prior negotiations, representations, or agreements, either written or oral. This Procurement Contract may not be altered, modified, or amended, except in writing signed by an authorized representative of both parties.

15.07 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 Procurement Contract.

15.08 Headings

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

15.09 Successors and Assigns

- A. Buyer and Seller each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Procurement Contract.

END OF DOCUMENT

DOCUMENT 00_73_01

SUPPLEMENTARY CONDITIONS - PROCUREMENT

Scope: These Supplementary Conditions amend or supplement Document 00_72_01 - General Conditions - Procurement and other provisions of the Procurement Documents as indicated in this Document. All provisions which are not so amended or supplemented remain in full force and effect.

ARTICLE 1 — DEFINITIONS

1.01 Defined Terms

SC-1.01 Defined Terms: Add the following definitions immediately after 1.01.40:

41. "Or Equal"—Alternate product that does not affect Contract Time, Contract Price, or Contract Scope.
42. Submittals—Shop Drawings, catalog cuts, samples, operating and maintenance instructions, progress payments, requests, and other documents and items specified to be delivered to Owner or Owner's representative.
43. Substitution - Alternate product that requires a Change Order to adjust the Contract Time, Contract Price, or Contract Scope.

ARTICLE 2 — PRELIMINARY MATTERS

2.04 Preliminary Schedules

SC-2.04 Add the following new paragraph immediately after Paragraph 2.04.A.2:

3. a preliminary Schedule of Values.

ARTICLE 3 — PROCUREMENT CONTRACT DOCUMENTS (NOT USED)

ARTICLE 4 — COMMENCEMENT AND SCHEDULE (NOT USED)

ARTICLE 5 — BONDS AND INSURANCE

5.01 Performance, Payment, and Other Bonds

SC-5.01 Add the following paragraphs immediately after Paragraph 5.01.A:

1. Required Performance Bond Form: The performance bond that Seller furnishes will be in the form of Document 00_61_14 - Performance Bond - Procurement.
2. Required Payment Bond Form: The performance bond that Seller furnishes will be in the form of Document 00_61_73 - Payment Bond - Procurement.

5.02 Insurance

SC-5.02 Add the following new paragraphs immediately after Paragraph 5.02.E:

- F. Seller shall purchase and maintain such liability and other insurance as is appropriate for the furnishing of Goods and Special Services and as will provide protection from claims set forth below which may arise out of or result from Seller's furnishing of the Goods or Special Services and Seller's other obligations under the Procurement Contract Documents, whether the furnishing of Goods and Special

Services or other obligations are to be performed by Seller, any subcontractor or supplier, or by anyone directly or indirectly employed by any of them to furnish the Goods and Special Services, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
2. claims for damages because of bodily injury, occupational sickness or disease, or death of Seller's employees;
3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Seller's employees;
4. claims for damages insured by reasonably available personal injury liability coverage which are sustained: (a) by any person as a result of an offense directly or indirectly related to the employment of such person by Seller, or (b) by any other person for any other reason;
5. claims for damages, other than to the Goods, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

G. The policies of insurance so required by this Paragraph 5.02 to be purchased and maintained must:

1. with respect to insurance required by Paragraphs SC-5.02.F.3 through SC-5.02.F.6 inclusive, include as additional insureds (subject to any customary exclusion in respect of professional liability) Buyer, Engineer, and their consultants, all of whom must be listed as additional insureds, and include coverage for the respective officers, directors, partners, employees, agents, and other consultants and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds must provide primary coverage for all claims covered thereby;
2. include at least the specific coverages and be written for not less than the limits of liability provided below or required by Laws or Regulations, whichever is greater;
3. include completed operations insurance;
4. include contractual liability insurance covering Seller's indemnity obligations under Paragraph 7.07;
5. 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 3 days of receipt of any such written notice, the purchasing policyholder will provide a copy of the notice to the other party, each other insured, and Engineer;
6. remain in effect at least until final payment and at all times thereafter when Seller may be correcting, removing, or replacing non-conforming Goods in accordance with Paragraph 9.03 and 9.04; and
7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least 2 years after final payment (and Seller shall furnish Buyer and each other additional insured identified in these Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Buyer and any such additional insured of continuation of such insurance at final payment and 1 year thereafter).

- H. The limits of liability for the insurance required by Paragraph SC-5.02.F must provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs SC-5.02.F.1 and F.2:

Workers' Compensation and Related Policies	Policy limits of not less than
Workers' Compensation	
State	Statutory
Applicable Federal	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory
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 workers' compensation or commercial general liability policy with a minimum limit of:	\$

2. Seller's General Liability under Paragraphs SC-5.02.F.3 through F.6 which must include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Seller:

Commercial General Liability	Policy limits of not less than
General Aggregate	\$2,000,000
Products—Completed Operations Aggregate	\$2,000,000
Personal and Advertising Injury	\$1,000,000
Bodily Injury and Property Damage—Each Occurrence	\$1,000,000

3. Automobile Liability under Paragraph SC-5.02.F.6:

Automobile Liability	Policy limits of not less than
Bodily Injury	
Each Person	\$1,000,000
Each Accident	\$1,000,000
Property Damage	
Each Accident	\$1,000,000
[or]	

Automobile Liability	Policy limits of not less than
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	\$1,000,000

4. Professional Liability (if the Special Services include professional services):

Seller's Professional Liability	Policy limits of not less than
Each Claim	\$2,000,000
Annual Aggregate	\$

5. Transportation Insurance: Transportation insurance shall be of the "all risks" type and shall protect Supplier and Owner from all insurable risks of physical loss or damage to equipment and materials in transit to the designated location. The coverage amount shall be not less than the full value of items exposed to risk in transit at any one time.
- a. Transportation insurance shall provide for losses to be payable to Supplier and Owner as their interests may appear and shall contain a waiver of subrogation rights against the insured parties. For insurance purposes, the risk of loss to equipment and materials shall remain with Supplier until the equipment and materials are accepted by the assignee general construction contractor at the designated location.
 - b. Supplier shall submit a copy of the transportation insurance policy to Owner at least 30 days before the scheduled shipping date. The policy shall quote the insuring agreement, shall list all exclusions, and shall state that 30 days' written notice will be given Owner before the policy is changed or canceled.
- I. Seller shall deliver to Buyer, with copies to each additional insured identified in these Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Buyer or any other additional insured) which Seller is required to purchase and maintain.

ARTICLE 6 — LICENSES AND FEES (NOT USED)

ARTICLE 7 — SELLER'S RESPONSIBILITIES (NOT USED)

ARTICLE 8 — SHIPPING AND DELIVERY (NOT USED)

ARTICLE 9 — BUYER'S RIGHTS

9.05 Limitation of Seller's Liability

SC-9.05 Add the following new heading and subsequent paragraphs after Paragraph 9.04:

9.05 Limitation of Seller's Liability

- A. Buyer and Seller agree that the total liability of Seller to Buyer for claims, costs, losses, and damages arising from this Procurement Contract will be limited to the amount established in the Procurement Agreement as the Procurement Contract Price.

- B. Upon assignment the terms of this Paragraph 9.05 will be binding upon both the assignor and assignee with respect to Seller's liability, The terms of this limitation do not apply to or limit any claim by Buyer against Seller based on any of the following: (a) contribution or indemnification with respect to third-party claims, losses, and damages; (b) costs, losses, or damages attributable to personal or bodily injury, sickness, disease, or death, or to injury to or destruction of the tangible property of others, (c) intentional or reckless wrongful conduct, or (d) rights conferred by any bond provided by Seller under this Contract.

ARTICLE 10 — ENGINEER'S STATUS (NOT USED)

ARTICLE 11 — CHANGES

11.02 Change Orders

SC-11.02 Insert the following new subparagraphs immediately following Paragraph 11.02.A.4:

5. In signing a Change Order, the Owner and Contractor acknowledge and agree that:
 - a. the stipulated compensation (Contract Price or Contract Times, or both) set forth in the Change Order includes not only all direct costs of Contractor such as labor, material, job overhead, and profit markup, but also includes any costs for modifications or changes in sequence of work to be performed, delays, rescheduling, disruptions, extended direct overhead or general overhead, acceleration, material or other escalation which includes wages and other impact costs. This Document will become a supplement to the Contract and all Contract provisions will apply hereto. It is understood that this Change Order shall be effective on the date approved by the Owner's Representative;
 - b. the Change Order constitutes full mutual accord and satisfaction for the change to the Work;
 - c. no reservation of rights to pursue subsequent claims on the Change Order will be made by either party; and
 - d. no subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.

ARTICLE 12 — CLAIMS, DISPUTES, AND DISPUTE RESOLUTION (NOT USED)

ARTICLE 13 — PAYMENT (NOT USED)

ARTICLE 14 — CANCELLATION, SUSPENSION, AND TERMINATION (NOT USED)

ARTICLE 15 — MISCELLANEOUS (NOT USED)

END OF DOCUMENT

SECTION 01_11_00
SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Detailed description of the Work.

1.02 THE WORK

- A. This equipment will be installed by a Contractor to be selected at a later date.
- B. Seller shall be responsible for designing, fabricating, testing, and delivering Electrical Distribution Equipment. Seller shall see that finished Goods and Services comply accurately with the Procurement Documents.
- C. The Goods generally includes, but is not limited to, the following:
 - 1. Furnishing electrical distribution equipment including switchboard, service entrance automatic transfer equipment, and all related accessories for a complete installation as described in these Procurement Bidding Documents.
 - a. A one-line diagram is included in Appendix A of these procurement documents.
 - 2. Services include submittals, shipment and delivery, start-up and commissioning services, and coordination with the Contractor during installation.

1.03 LOCATION OF PROJECT

- A. The Work is located at the Point of Destination as defined in Section 00_52_64 - Agreement Between Buyer and Seller - Procurement.

1.04 OWNER FURNISHED EQUIPMENT

- A. Owner will:
 - 1. Issue all communications to Seller through Engineer.
 - 2. Arrange for and deliver necessary Shop Drawings, product data, and samples to Contractor.
 - 3. Inspect deliveries jointly with Contractor.
 - 4. Submit claims for transportation damage.
 - 5. Arrange for replacement of damaged, defective, or missing items.
 - 6. Arrange for manufacturer's warranties, bonds, service, and inspections.
- B. Contractor's responsibility for Owner-furnished products:
 - 1. Designating delivery date for each Owner-furnished product.
 - 2. Reviewing Shop Drawings, product data, and samples.
 - 3. Submitting notification of discrepancies or anticipated problems.

4. Receiving and unloading products at site.
5. Promptly inspecting products jointly with Owner and recording shortages, and damaged or defective items.
6. Handling products at site, including uncrating and storage.
7. Protecting products from damage.
8. Installing, including assembly, connections, adjustments, and commissioning in accordance with Contract Documents.
9. Providing operating oils, lubricants, and incidental materials required for complete installation.
10. Repairing or replacing items damaged after receipt until date of Substantial Completion of the Work by Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_33_00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements and procedures for Submittals to confirm compliance with the Contract Documents.

1.02 GENERAL INSTRUCTIONS

- A. Contractor is responsible to determine and verify field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and check and coordinate each item with other applicable approved Shop Drawings and Contract Document requirements.
- B. Provide Submittals:
 - 1. That are specified or reasonably required for construction, operation, and maintenance of the Work.
 - 2. That demonstrate compliance with the Contract Documents.
- C. Where multiple Submittals are required, provide a separate Submittal for each Specification section.
 - 1. In order to expedite construction, the Contractor may make more than one Submittal per Specification section, but a single Submittal may not cover more than one Specification section:
 - a. The only exception to this requirement is when one Specification section covers the requirements for a component of equipment specified in another section.
 - b. For example, circuit breakers are a component of switchgear. The switchgear Submittal must also contain data for the associated circuit breakers, even though they are covered in a different Specification section.
- D. Prepare Submittals in the English language. Do not include information in other languages.
- E. Present measurements in customary American units (feet, inches, pounds, etc.).
- F. Must be clear and legible, and of sufficient size for presentation of information.
- G. Page size, other than drawings:
 - 1. Minimum: 8-1/2 inches by 11 inches.
 - 2. Maximum: 11 inches by 17 inches.

- H. Drawing sheet size:
 - 1. Maximum: 22 inches by 34 inches.
 - a. Minimum plan scale: 1/8 inch equals 1 foot-0 inches.
 - b. Minimum font size: 1/8-inch.
 - 2. 11-inch by 17-inch sheet:
 - a. Minimum plan scale: 1/8 inch equals 1 foot-0 inches.
 - b. Minimum font size: 1/8-inch.
- I. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.
- J. Provide Submittal information from only one manufacturer for a specified product. Submittals with multiple manufacturers for one product will be rejected without review.

1.03 SUBMITTAL ORGANIZATION

- 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 used.
- C. Bookmarks:
 - 1. Bookmarks shall match the table of contents.
 - 2. Bookmark each section (tab) and heading.
 - 3. Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
 - 4. At file opening, display all levels of bookmarks as expanded.
- D. Where applicable (i.e., except for Drawings, figures, etc.), Submittal content shall be electronically searchable utilizing the PDF file as submitted.
- E. Thumbnails optimized for fast web viewing.
- F. Sequentially number pages within the tabbed sections:
 - 1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.
- G. Attachments:
 - 1. Include with each Submittal a copy of the relevant Specification section.
 - a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).
 - b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
 - 2. Include with each Submittal a copy of the relevant Drawing, including relevant addendum updates.
 - a. Indicate either compliance with a check (✓) or deviation with a consecutive number (1, 2, 3).

- b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
 - c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.
- H. Contractor: Prepare Submittal information in sufficient detail to show compliance with specified requirements.
 - 1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
 - 2. Coordinate Submittal with other Submittals and with the requirements of the Contract Documents.
 - 3. Check, verify, and revise Submittals as necessary to bring them into conformance with the Contract Documents and actual field conditions.
- I. Contractor: Prepare "Or Equal" Submittal information.
 - 1. Provide standard Submittal requirements.
 - a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
 - 2. Provide reason the specified product is not being provided.
 - 3. Explain the benefits to the Owner for accepting the "Or Equal".
 - 4. Itemized comparison of the proposed "Or Equal" with product specified, including a list of significant variations:
 - a. Design features.
 - b. Design dimensions.
 - c. Installation requirements.
 - d. Operations and maintenance requirements.
 - e. Availability of maintenance services and sources of replacement materials.
 - 5. Reference projects where the product has been successfully used:
 - a. Name and address of project.
 - b. Year of installation.
 - c. Year placed in operation.
 - d. Name of product installed.
 - e. Point of contact: Name and phone number.
 - 6. Define impacts:
 - a. Impacts to other contracts.
 - b. Impacts to other work or products.
 - 7. Contractor represents the following:
 - a. Contractor bears the burden of proof of the equivalency of the proposed "Or Equal".
 - b. Proposed "Or Equal" is equal or superior to the specified product.
 - c. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed "Or Equal", unless the Owner requires a Special Warranty.
 - d. Contractor will coordinate installation of accepted "Or Equal" into the Work and will be responsible for the costs to make changes as required to the Work.
 - e. Contractor waives rights to claim additional costs caused by proposed "Or Equal" which may subsequently become apparent.

- J. Contractor: Prepare substitution Submittal information.
1. Provide standard Submittal requirements.
 - a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
 2. Provide reason the specified product is not being provided.
 3. Explain the benefits to the Owner for accepting the substitution.
 4. Itemized comparison of the proposed substitution with product specified, including a list of significant variations:
 - a. Design features.
 - b. Design dimensions.
 - c. Installation requirements.
 - d. Operations and maintenance requirements.
 - e. Availability of maintenance services and sources of replacement materials.
 5. Reference projects where the product has been successfully used:
 - a. Name and address of project.
 - b. Year of installation.
 - c. Year placed in operation.
 - d. Name of product installed.
 - e. Point of contact: Name and phone number.
 6. Define impacts:
 - a. Impacts to Contract Price.
 - 1) Required license fees or royalties.
 - 2) Do not include costs under separate contracts.
 - 3) Do not include Engineer's costs for redesign or revision of the Contract Documents.
 - b. Impacts to Contract Time.
 - c. Impacts to Contract Scope.
 - d. Impacts to other contracts.
 - e. Impacts to other work or products.
 7. Contractor represents the following:
 - a. Contractor shall pay associated costs for the Engineer to evaluate the substitution.
 - b. Contractor bears the burden of proof of the equivalency of the proposed substitution.
 - c. Proposed substitution does not change the design intent and will have equal performance to the specified product.
 - d. Proposed substitution is equal or superior to the specified product.
 - e. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed substitution, unless the Owner requires a Special Warranty.
 - f. Contractor will coordinate installation of accepted substitution into the Work and will be responsible for the costs to make changes as required to the Work.
 - g. Contractor waives rights to claim additional costs caused by proposed substitution which may subsequently become apparent.

1.04 SUBMITTAL IDENTIFICATION NUMBERING

A. Number each Submittal using the format defined in the table below:

	Spec Section Number	Dash	Initial Submittal - Sequential Number	Decimal Point	Subsequent Submittal Revisions Sequential Number
<i>Example 1 Description</i>	<i>Cast-In-Place Concrete</i>		<i>8th initial Submittal</i>		
	03_30_00	-	0008		
<i>Example 2 Description</i>	<i>Cast-In-Place Concrete</i>		<i>8th initial Submittal</i>		<i>First revision to the 8th initial Submittal</i>
	03_30_00	-	0008	.	1

1.05 SUBMITTALS IN ELECTRONIC MEDIA FORMAT

A. General:

1. Provide all information in PC-compatible format using Windows® operating system as utilized by the Owner and Engineer.

B. Text:

1. Provide text documents and manufacturer's literature in native, text-based Portable Document Format (PDF) suitable for searching, copying, and electronic review. Scanned or image-based PDFs are not acceptable.

C. Graphics:

1. Provide graphic Submittals (Drawings, diagrams, figures, etc.) utilizing Portable Document Format (PDF).

1.06 SUBMITTAL PROCEDURE

A. Engineer: Review Submittal and provide response:

1. Review description:
 - a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular Submittal, whether or not a stamp or seal is required by the Contract Documents or Laws and Regulations.
 - b. Engineer's review of Submittals shall not release the Contractor from the Contractor's responsibility for performance of requirements of the Contract Documents. Neither shall the Engineer's review release the Contractor from fulfilling purpose of installation nor from the Contractor's liability to replace defective Work.
 - c. Engineer's review of Shop Drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in the Contract Documents.

- d. Engineer's review does not extend to:
 - 1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by the Contractor.
 - 2) Contractor's means, methods, techniques, sequences, or procedures, except when specified, indicated on the Drawings, or required by the Contract Documents.
 - 3) Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.
- e. Engineer can Approve or Not Approve any exception at their sole discretion.
- 2. Review timeframe:
 - a. Except as may be provided in the Technical Specifications, a Submittal will be returned within 30 days.
 - b. When a Submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the Submittal, give notice of the date by which that Submittal will be returned.
 - c. Engineer's acceptance of progress schedule containing Submittal review times less than those specified or agreed to in writing by the Engineer will not constitute Engineer's acceptance of review times.
 - d. Critical Submittals:
 - 1) Contractor will notify Engineer in writing that timely review of a Submittal is critical to the progress of Work.
- 3. Schedule delays:
 - a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of Submittals unless all of the following criteria are met:
 - 1) Engineer has failed to review and return first submission within the agreed upon time frame.
 - 2) Contractor demonstrates that delay in progress of Work is directly attributable to the Engineer's failure to return Submittal within time indicated and accepted by the Engineer.
- 4. Review response will be returned to the Contractor with one of the following dispositions:
 - a. No Exceptions:
 - 1) There are no notations or comments on the Submittal and the Contractor may release the equipment for production.
 - b. Make Corrections Noted - See Comments:
 - 1) Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
 - 2) Resubmittal not required.
 - c. Make Corrections Noted - Confirm:
 - 1) Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
 - 2) Submit confirmation specifically addressing each notation or comment to the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.
 - d. Correct and Resubmit:
 - 1) Contractor may not proceed with the Work described in the Submittal.
 - 2) Contractor assumes responsibility for proceeding without approval.

- 3) Resubmittal of complete Submittal package is required within 30 calendar days of the date of the Engineer's Submittal review response.
 - e. Rejected - See Remarks:
 - 1) Contractor may not proceed with the Work described in the Submittal.
 - 2) Submittal does not meet the intent of the Contract Documents. Resubmittal of complete Submittal package is required with materials, equipment, methods, etc., that meet the requirements of the Contract Documents.
 - f. Receipt Acknowledged - Filed for Record:
 - 1) This is used in acknowledging receipt of informational Submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc.
 - g. Receipt Acknowledged With Comments - Resubmit:
 - 1) This is used in acknowledging receipt of informational Submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc. Feedback regarding missing information, conflicting information, or other information that makes it incomplete can be made with comments.
- B. Contractor: Prepare resubmittal, if applicable:
1. Clearly identify each correction or change made. Provide page references to the changed information within the resubmittal.
 2. Include a response in writing to each of the Engineer's comments or questions for Submittal packages that are resubmitted in the order that the comments or questions were presented from the first and subsequent Submittals and numbered consistent with the Engineer's numbering.
 - a. Acceptable responses to the Engineer's comments are listed below:
 - 1) "Incorporated" - Engineer's comment or change is accepted and appropriate changes are made.
 - 2) "Response" - Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by the Engineer.
 - b. Reviews and resubmittals:
 - 1) Contractor shall provide resubmittals which include responses to all Submittal review comments separately and at a level of detail commensurate with each comment.
 - 2) Contractor responses shall indicate how the Contractor resolved the issue pertaining to each review comment
 - a) Responses such as "acknowledged" or "noted" are not acceptable.
 - 3) Resubmittals which do not comply with this requirement may be rejected and returned without review.
 - 4) Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non-compliant Submittals.
 - 5) Submittal review comments not addressed by the Contractor in resubmittals shall continue to apply whether restated or not in

- subsequent reviews until adequately addressed by the Contractor to the satisfaction of the reviewing and approving authority.
- c. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for revision and resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.
3. Resubmittal timeframe:
- a. Contractor shall provide resubmittal within 30 days.
 - b. When a resubmittal cannot be returned within the specified period, Contractor shall notify the Engineer in writing.
4. Review costs:
- a. Costs incurred by the Owner as a result of additional reviews of a particular Submittal after the second time it has been reviewed shall be borne by the Contractor.
 - b. Reimbursement to the Owner will be made by deducting such costs from the Contractor's subsequent progress payments.

1.07 PRODUCT DATA

- A. Edit Submittals so that the Submittal specifically applies to only the product furnished.
- B. Neatly cross out all extraneous text, options, models, etc., that do not apply to the product being furnished so that the information remaining is only applicable to the product being furnished.

1.08 SHOP DRAWINGS

- A. Contractor to field verify elevation, coordinates, and pipe material for pipe tie-in to pipeline or structure prior to the preparation of Shop Drawings.
- B. Indicate project-designated equipment tag numbers for Submittal of devices, equipment, and assemblies.

1.09 SAMPLES

- A. Details:
 - 1. Submit labeled samples.
 - 2. Samples will not be returned.
 - 3. Provide number of sample Submittals as below:
 - a. Total: 3 minimum.
 - 1) Owner: 1.
 - 2) Engineer: 2.
 - 3) Contractor: None.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - CONTRACTOR SUBMITTAL TRANSMITTAL FORM

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

Owner:	Click here to enter text.	Date:	MM/DD/YYYY
Contractor:	Click here to enter text.	Project No.:	XXXXX.XX
Project Name:	Click here to enter text.	Submittal Number:	000
Submittal Title:	Click here to enter text.		
To:	Click here to enter text.		
From:	Click here to enter text.	Click here to enter text.	
	Click here to enter text.	Click here to enter text.	

Specification No. and Subject of Submittal/Equipment Supplier			
Spec ##:	Spec ##.	Subject:	Click here to enter text.
Authored By:	Click here to enter text.		Date Submitted: XX/XX/XXXX

Submittal Certification	
Check Either (A) or (B):	
☐ (A)	We have verified that the equipment or material contained in this Submittal meets all the requirements specified in the project manual or shown on the Contract Drawings with no exceptions.
☐ (B)	We have verified that the equipment or material contained in this Submittal meets all the requirements specified in the project manual or shown on the Contract Drawings, except for the deviations listed.
Certification Statement: By this Submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved Shop Drawings and all Contract requirements.	
General Contractor's Reviewer's Signature:	
Printed Name:	

PM/CM Office Use	
Date Received GC to PM/CM:	Click here to enter text.
Date Received PM/CM to Reviewer:	Click here to enter text.
Date Received Reviewer to PM/CM:	Click here to enter text.
Date Sent PM/CM to GC:	Click here to enter text.

SECTION 01_35_73

DELEGATED DESIGN PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Delegated Design procedures.

1.02 GENERAL

- A. Delegated Design - Professional design services assigned to the Contractor by express delegation in the Contract Documents. Work is "Delegated Design" where the Technical Sections require the Contractor to provide professional design services and to submit signed and sealed documents from a registered Professional Engineer.
- B. Contractor's Professional Engineer - The design professional retained by the Contractor to perform Delegated Design.
- C. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents.
 - 1. Requirements of Delegated Design component as specified in the Technical Section and as indicated on the Drawings.
 - 2. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that the Contractor must furnish to the Engineer with respect to the Delegated Design.
- D. Contractor shall cause such Delegated Design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal shall appear on Drawings, calculations, Specifications, certifications, and Submittals prepared by such design professional.
 - 1. Contractor shall not be responsible for the adequacy of performance or design criteria specified by the Owner or Engineer.
 - 2. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.
 - 3. Such design professional shall issue certifications of design required by Laws and Regulations.
 - 4. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by the Contractor, a Subcontractor, or others for submittal to the Engineer, then such Shop Drawing or other Submittal shall bear the written approval of Contractor's design professional when submitted by the Contractor to the Engineer.
- E. 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 Delegated

Design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

- F. Engineer's review, approval, and other determinations regarding design drawings, calculations, Specifications, certifications, and other Submittals furnished by Contractor pursuant to a Delegated Design will be only for the following limited purposes:
 - 1. Confirming that Submittal is in conformance with the performance and design criteria specified in the Contract Documents.

1.03 CONTRACTOR'S PROFESSIONAL ENGINEER

- A. Contractor or Subcontractor shall retain a licensed Professional Engineer to perform Delegated Design.
- B. Qualifications:
 - 1. Holding a current license to perform the specified design in the same jurisdiction as the Project Site.
 - 2. Experienced in designing similar systems of similar complexity.
- C. Insurance:
 - 1. Provide Contractor's Professional Engineer's Professional Liability Insurance as specified in Section 00_73_00 - Supplementary Conditions.
- D. Responsibilities:
 - 1. Review and design in accordance with system performance and design criteria stated in the Contract Documents.
 - a. Prepare written requests for clarifications or interpretations of performance or design criteria for submittal to the Engineer by the Contractor.
 - 2. Sign and seal design reports, calculations, design drawings and specifications, and other design Submittals for the Delegated Design Work.
 - 3. Review and submit written approval of Submittals related to the Delegated Design Work.
 - 4. Design modifications to the Delegated Design Work as required.
 - 5. Visit the Site, as required, to verify that installation of the Delegated Design Work is in conformance with the Delegated Design Drawings and Specifications.
 - 6. Submit through Contractor to Engineer written, signed, and sealed certification that the installed Delegated Design Work complies with Contractor's Professional Engineer's design.

1.04 SUBMITTALS

- A. Prior to the start of Delegated Design:
 - 1. Contractor's Professional Engineer's qualifications:
 - a. Experience for the Delegated Design.
 - b. Evidence of Professional Engineering license.
 - 2. Contractor's Professional Engineer Professional Liability Insurance certificate.

- B. Delegated Design:
 - 1. Product data:
 - a. Details related to the Delegated Design as specified in Technical Sections to completely describe the system.
 - 2. Design documents with signature and seal from the Contractor's Professional Engineer.
 - a. Design documents include, but are not limited to, Drawings, calculations, Specifications, inspection reports, and certifications.
 - 3. Lists and schedules:
 - a. Prepare and submit lists or schedules of items where Delegated Design is required by the Contract Documents.
 - b. Group items by location in the Work.
 - 1) When "Area Numbers" are indicated on the Contract Drawings, group lists in accordance with those "areas."
 - 2) For work without area numbers, group using logical divisions acceptable to the Engineer.
 - 3) Group items within each "area" as follows:
 - a) Systems.
 - b) Components.
 - c) Supports.
 - d) Anchorage.
 - e) Bracing.
- C. Construction services:
 - 1. Contractor's Professional Engineer's comments on Submittals.
 - 2. Other construction documents, as required.

1.05 ENGINEER RESPONSE TO DELEGATED DESIGN SUBMITTALS

- A. Engineer response will be either of the following:
 - 1. Approved. Make Corrections Noted - See Comments:
 - a. Contractor may proceed with the Work; however, all notations and comments must be incorporated into the final product.
 - b. Review was for the limited purpose of determining that the document was stamped by a Professional Engineer and that such design is generally consistent with and will not negatively affect the design concept presented in the Contract Documents.
 - 2. Rejected - See Remarks:
 - a. Contractor may not proceed with the Work described in the Submittal.
 - b. Submittal does not meet the intent of the Contract Documents.
 - c. Resubmittal of complete Submittal package is required with materials, equipment, methods, etc., that meet the requirements of the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_75_17

COMMISSIONING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
1. Commissioning.

1.02 DEFINITIONS

- A. Commissioning: The process of planning for, testing of, and start-up of systems, subsystems, equipment, components, and devices of the Work to demonstrate, through documented verification, that the Work has successfully met the Contract Documents. It includes training the Owner's staff on operation and maintenance of the installed Work.
- B. Commissioning Phases: The activities of commissioning are grouped into the phases defined in the following table.
1. Table 1 - Commissioning Phases.

TABLE 1 - COMMISSIONING PHASES		
Planning Phase	Testing and Training Phase	Start-Up Phase
Draft Test Plans	Source Testing: • Documentation	Start-Up: • Documentation • Owner Training
	Installation Verification: • Documentation • Owner Training	
	Functional Testing: • Documentation • Owner Training	

2. Attachment A provides Commissioning Flowcharts.
- C. Component: A part of a system that does not have an electrical connection or internal electronics. Examples: Piping and pressure gauges.
- D. Device: A part of a system that has electrical connections or internal electronics. Examples: Level transmitter or pressure transmitter.
- E. Electrical Energization Plan: A plan to manage how and when power is applied to electrical equipment.
- F. Equipment: A factory or field assembled apparatus that performs an identifiable function. Examples: Pumps, motors, VFDs, MCCs.

- G. Functional Testing: Testing performed on a completed subsystem or system to demonstrate that the system meets the specified requirements. Example systems: Backwash system, dewatering system.
- H. Installation Verification: Testing to demonstrate that equipment or system and associated components or devices have been properly installed. Example equipment: Pumps, meters, and blowers with associated piping.
- I. Manufacturer's Certificate of Functional Compliance: The form completed by the manufacturer to confirm that testing of the installed equipment or system has been performed and the results conform to the specified performance. The form is provided in Attachment D provided at the end of this Section.
- J. Manufacturer's Certificate of Installation Verification: The form completed by the manufacturer to confirm that the equipment or system is installed in conformance with the Contract. The form is provided in Attachment C at the end of this Section.
- K. Manufacturer's Certificate of Source Testing: The form completed by the manufacturer to confirm that the specified source tests have been performed and the results conform to the specified requirements. The form is provided in Attachment B at the end of this Section.
- L. Owner Training: The Owner's staff is trained by the Contractor, with assistance from manufacturer, to operate and maintain the completed Work. This is sometimes referred to as Vendor Specific Training.
- M. Process Stream: A series of liquid or solids flow processes that are designed to improve the water quality to meet regulatory permit requirements.
- N. Source Testing: Test equipment or products for performance at point of manufacture or assembly for the requirements specified in the Contract Documents. Also referred to as factory testing and factory acceptance testing (FAT).
- O. Start-Up: Operating the Work with process water to verify the Work meets the Contract Documents.
- P. Start-Up Phase: The phase when Start-Up occurs.
- Q. Subsystem: A grouping of equipment, components, and devices that is a part of a larger system and that perform a single definable function. Examples: Sand filters, filter backwash.
- R. System: A grouping of equipment, components, and devices that perform a single definable function. If a system is a part of a larger system, it is referred to as a subsystem.
 - 1. Examples: Flocculation and sedimentation, filtration.
- S. System Testing: Testing of a completed system for an extended time period. Examples: Headworks, filtration.

- T. Water Management Plan: A plan to manage the test water used for commissioning from source to disposal. The test water may be clean water, potable water, non-potable water, or process water (e.g., raw water, plant water, sludge). The plan demonstrates how water will be produced, conveyed, treated, disposed of as directed by the plant manager, and/or recycled.

1.03 SUBMITTALS

A. Project Commissioning:

1. Commissioning Coordinator's qualifications.
 - a. Submit to Engineer no later than 30 days after Notice to Proceed.
 - b. Describe previous similar experience on similar projects with a list of references, including phone numbers.
 - c. Provide names and qualifications of commissioning assistants, if applicable.
2. Schedules:
 - a. Commissioning Schedule containing all commissioning activities.
 - b. Owner Training Schedule.
3. Test Plans:
 - a. Submit draft Test Plan outlined in the Planning Phase, unless specified otherwise.
 - 1) Engineer approval of draft Test Plans required for successful completion of Planning Phase.
 - b. Submit final Test Plan a minimum of 120 calendar days prior to testing.
 - c. Engineer approval of final Test Plan required prior to start of testing.
4. Test Reports:
 - a. Submit draft Test Reports outline in the Planning Phase, unless specified otherwise.
 - 1) Engineer approval of draft Test Reports outline required for successful completion of Planning Phase.
 - b. Submit final Test Report a maximum of 30 calendar days after testing.

B. Technical Sections Commissioning:

1. Manufacturer's representative's qualifications.
 - a. Submit to Engineer no later than 30 days in advance of required services.
 - b. Representative's name, phone, and e-mail address:
 - 1) May use 2 representatives: 1 for field testing and 1 for Owner Training.
 - 2) Provide resume stating instructor's technical expertise and instructional technology skills and experience.
2. Test Plans:
 - a. Submit draft Test Plan outlined in the Planning Phase, unless specified otherwise.
 - 1) Engineer approval of draft Test Plans required for successful completion of Planning Phase.
 - b. Submit final Test Plan a minimum of 120 calendar days prior to testing.
 - c. Engineer approval of final Test Plan required prior to start of testing.
3. Test Reports:
 - a. Submit draft Test Reports outline in the Planning Phase, unless specified otherwise.
 - 1) Engineer approval of draft Test Reports outline required for successful completion of Planning Phase.

- b. Submit final Test Report a maximum of 30 calendar days after testing.
- 4. Manufacturer's representatives field notes and data.
- 5. Owner Training:
 - a. Prior to the training session:
 - 1) Training instructor qualifications.
 - 2) Training course materials: Due 30 calendar days prior to initial training session.
 - a) If Owner requires, Continuing Education Units (CEUs), submit training materials to state regulatory agency in sufficient time to obtain approval for training prior to the training.
 - b) Drafts of training agenda, lesson plan, presentation, handouts, and list of audio-visual aids.
 - c) Format: 1 electronic copy in the format specified by the Owner and 3 hard copies organized in notebooks.
 - b. Post training session:
 - 1) Training course materials: Due 14 calendar days after class completion.
 - a) Recordings.
 - b) Class attendance sheet.
 - c) Final version of training agenda, final lesson plan, presentation, handouts, and audio-visual aids.
 - d) Format: 1 electronic copy in the format specified by the Owner and 3 hard copies organized in notebooks.
 - 2) Provide materials for all sessions of the class in a single transmittal.
 - 3) If the Owner requires training CEUs, issue training CEU certificates approved by the state regulatory agency to Owner's staff who successfully completed the training.

1.04 COMMISSIONING COORDINATOR (CC)

- A. Responsibilities include the following:
 - 1. Part-time person.
 - 2. Become thoroughly familiar with Contract Commissioning requirements.
 - 3. Provide the primary interface with Engineer and Owner for Commissioning efforts.
 - 4. Lead Commissioning efforts - all phases and tasks.
 - 5. Coordinate training efforts.
 - 6. Meetings:
 - a. CC is responsible for setting Commissioning coordination meeting dates and times, as well as preparing the agendas and meeting minutes.
 - b. CC shall conduct Commissioning progress meetings throughout construction, to plan, scope, coordinate, and schedule future activities, resolve problems, etc.
 - c. Frequency: Monthly minimum. Increase frequency as needed based on complexity and quantity of Commissioning activities.
- B. CC on site:
 - 1. Notice to Proceed to 30 percent milestone: 2 hours per week.
 - 2. 30 percent milestone to 70 percent milestone: 1 day per week.
 - 3. Testing and Training Phase: Full-time.
 - 4. Start-Up Phase: Full-time.

1.05 MANUFACTURER'S REPRESENTATIVES

- A. Qualifications: As specified below and in the Technical Sections:
 - 1. For Installation and Functional Testing:
 - a. Factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
 - 2. Training instructor qualifications:
 - a. Provide resume stating instructor's technical preparation and instructional technology skills and experience.
 - b. If CEUs are required, the operator training instructors must comply with state regulatory.
 - c. Knowledgeable in the equipment/system for which they are training.
 - d. Experienced in conducting classes.
 - e. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
 - 3. Representatives to be approved by Owner and Engineer.
 - 4. No substitute representatives without written approval by Owner and Engineer.
- B. Duties:
 - 1. Determine if additional time and/or trips (beyond those specified in the Technical Sections) is required to perform the specified services.
 - 2. Coordinate services in accordance with the Contractor's Project schedule, up to and including making multiple trips to the Project Site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.
 - 3. Perform on-site services as specified in the Technical Sections.
 - 4. Provide weekly copies of manufacturer's representatives field notes and data to Contractor.

1.06 PLANNING PHASE

- A. Overview of Planning Phase:
 - 1. Define approach and timing for Commissioning.
 - 2. Obtain Engineer approval of draft Test Plans.
- B. Test Plans.
 - 1. Define approach and timing for:
 - a. Testing and Training Phases.
 - 1) Major systems, with separate plans for each system.
 - b. Start-Up Phase.
 - 2. Source Test (Factory Acceptance Test) and Functional Test Plans:
 - a. As specified in this Section and other Technical Sections.
 - b. Based on approved Shop Drawings.
 - c. Prepared by the Contractor.
 - d. Include the following items for each test:
 - 1) Purpose of the test.

- 2) Identification of each item of equipment/system to be tested, including system designation, location, tag number, control loop identifier, etc.
- 3) Description of the pass/fail criteria that will be used.
- 4) Listing of pertinent reference documents (Contract and industry standards or sections applicable to the testing).
 - a) Credentials of test personnel.
- 5) Test equipment:
 - a) Include Product Data for the test equipment.
 - b) Appropriate calibration records.
 - (1) Drawings or photographs of test stands and/or test apparatus.
- 6) Duration: Determine test durations with Owner's input.
- 7) Detailed step-by-step test procedures.
 - a) Level of detail shall be sufficient for the witness to follow the steps.
- e. Define for Functional Testing:
 - 1) Required temporary systems (pumps, piping, etc.).
 - 2) Shutdown requirements for existing systems.
- f. Furnish labor, power, tools, equipment, instruments, and services required for and incidental to testing activities.
3. Test forms minimum requirements:
 - a. Name of product to be tested.
 - b. Test date.
 - c. Names of persons conducting the test.
 - d. Names of persons witnessing the test, where applicable.
 - e. Test data.
 - f. Applicable project requirements as specified in the Technical Sections.
 - g. Check offs for each completed test or test step.
 - h. Place for signature of person conducting tests and for the witnessing person, as applicable.
4. Owner responsibilities:
 - a. Owner will schedule staff within the constraints of their workloads.
 - 1) Those who will participate in this test have existing full-time work assignments, and testing is an additional assigned work task, therefore, scheduling is imperative.
 - 2) Treatment facilities are typically operated on an around-the-clock basis and are staffed in work shifts.
 - 1) Maximum hours per day available for commissioning activities: 8.
 - 2) Days available for commissioning activities: Monday to Thursday.
 - 3) Scheduling coordination with the CC.
5. CC is responsible for the following:
 - a. Coordinate schedule with the Owner's personnel and manufacturer's representatives (instructors).
- C. Test Reports:
 1. Minimum requirements:
 - a. Title.
 - b. Abstract.
 - c. Equipment.
 - d. Procedures.

- e. Results.
 - 1) Complete disclosure of the calculation methodologies.
- f. Conclusions.
- g. Signature by an authorized party.
- h. Appendices.
 - 1) Completed test forms signed by witnesses.
- 2. Water Management Plan:
 - a. Requirements:
 - 1) Demonstrate how water will be produced, conveyed, treated, recycled, and or disposed until testing verifies specified requirements.
- 3. Commissioning Schedule:
 - a. Content:
 - 1) Comply with Attachment G - Functional Testing Requirements and provide activities organized by system and subsystem.
 - 2) Include:
 - a) Source Testing when required.
 - b) Functional Testing.
 - c) Owner Training.
 - 3) Comply with Attachment F - Commissioning Roles and Responsibilities Matrix.
 - b. Procedures:
 - 1) Submit Commissioning Schedule as specified in Section 01_32_21 - Schedules and Reports.

1.07 TESTING AND TRAINING PHASE

A. Overview of Testing and Training Phase:

- 1. General:
 - a. Contractor tests the Work to verify it meets the Contract requirements.
 - b. Contractor trains the Owner to operate and maintain the Work.
- 2. Contractor responsibilities:
 - a. Furnish labor, tools, equipment, instruments, and services required for and incidental to completing Commissioning activities in accordance with the approved Commissioning Plans.
- 3. Owner responsibilities:
 - a. Furnish labor, power, chemicals, and services required for and incidental to completing Commissioning activities in accordance with the approved Commissioning Plans.
 - b. Owner provided services, equipment, and/or materials to be as specified in Section 01_11_00 - Summary of Work.

B. Source Testing:

- 1. As specified in the Technical Section.
- 2. Source Test Plan:
 - a. Engineer approval of Source Test Plan required prior to testing.
- 3. Witnessed in person:
 - a. As specified in the Technical Section.

- b. Contractor is responsible for trip costs associated with Owner's and Engineer's representatives.
 - 1) Transportation:
 - a) Commercial airline costs to and from the Salt Lake City International Airport, including related fees.
 - b) Rental car to and from arrival airport, hotel, and test site, including related fees.
 - 2) Hotel/Meals:
 - a) Hotel with an American Automobile Association 3 Diamond rating or higher equivalent for single occupancy room per person per day.
 - b) Meal allowance based on state government per diem guidelines per test site location.
 - c. When factory is located outside of the United States, Contractor is responsible for costs associated with additional security of Owner's and Engineer's representatives, including armed escorts, as determined appropriate by the Owner and/or Engineer.
4. Virtual witness testing:
- a. As specified in the Technical Sections.
 - b. Contractor is responsible for costs associated with virtual witness.
 - c. Provide the following:
 - 1) An agenda detailing start time of each major phase in the procedure defined in the approved Test Plan.
 - 2) A dedicated operator (separate from the test technician) to operate the camera, provide commentary throughout test, and inspect devices at the request of the attendees.
 - d. Online meeting platform: Microsoft Teams.
 - e. Share video through a high-definition camera.
 - f. Establish methods to communicate, convey, and record information clearly even in environments with loud background noise.
 - 1) Electronic feed for screen sharing of the control panel, HMI, or other screens used throughout testing.
 - 2) Provide recording of virtual sharing within 1 day after testing.
 - g. Test run of virtual sharing a minimum of 1 week prior to the test:
 - 1) Use current record documents in PDF format.
 - 2) Provide recording of virtual sharing within 1 day after the test run.
 - 3) Engineer approval of test run virtual sharing is required before Source Testing.
5. If the Source Test is not ready on the scheduled date or if the Source Test fails:
- a. Contractor is responsible for associated costs:
 - 1) First test costs that are non-refundable, if applicable.
 - 2) Repeat test costs:
 - a) Trip costs, if applicable.
 - 3) Virtual witness costs, if applicable.
 - a) Witness labor costs:
 - (1) Travel time and witness time are included, if applicable.
 - (2) The greater of \$200 per hour or \$1,600 per day.
6. Source Testing is complete after successful testing, submittal of test report, and Manufacturer's Certificate of Source Testing.
7. Engineer approval of Source Testing Report is required.

- C. Installation Verification:
1. Overview:
 - a. Verifying the installation of equipment to be in accordance with Manufacturer's Instructions.
 2. Prerequisite:
 - a. Engineer approval of Source Testing Report.
 3. Perform checks:
 - a. Structural anchorage check.
 - b. Electrical energization check.
 - 1) As specified in the flowchart shown in Attachment A.
 - c. Health and safety check.
 4. Submit Manufacturer's Certificate of Installation Verification.
 5. Engineer approval of Manufacturer's Certificate of Installation Verification is required.
- D. Functional Testing:
1. Overview:
 - a. Testing the function of a system or subsystem.
 2. Prerequisites:
 - a. Engineer approval of Manufacturer's Certificate of Installation Verification.
 - b. Engineer approval of Functional Test Plan required prior to testing.
 - c. Draft Operations and Maintenance Manual as specified in Section 01_78_24 - Operations and Maintenance Manual.
 - d. Completed pipe, valve, and gate labeling of system or subsystem.
 - 1) As specified in Section 40_05_00.03 - Pipe Identification prior to the start of Functional Testing.
 3. Witnessed.
 4. Discipline checks:
 - a. Verify support systems function properly, such as seal water, pipes, valves, etc.
 - b. As specified in the individual Technical Sections.
 5. Consecutive Day Test:
 - a. Operate the Work as specified in Attachment G - Functional Testing Requirements and as specified in the individual Technical Sections.
 - 1) Successful completion of subsystem testing required prior to system testing.
 - b. Failure response time:
 - 1) Be equipped and ready to provide emergency repairs, adjustments, and corrections to comply with the "Significant Interruption Duration" requirements as specified in Attachment G - Functional Testing Requirements.
 - c. Duration:
 - 1) As specified in Attachment G - Functional Testing Requirements.
 - 2) Restart the consecutive day test when the system performance failures exceed the "Significant Interruption Duration" time period specified in Attachment G - Functional Testing Requirements.
 - a) Individual equipment/system failures that are corrected within the "Significant Interruption Duration" time specified in Attachment G - Functional Testing Requirements shall not require the consecutive day test to be restarted unless the failure recurs.

- b) Engineer has the authority to reject the consecutive day test if individual equipment/system failures are repetitive.
 - 6. Instrumentation and controls tests.
 - a. Loop Validation Tests.
 - b. Complete End-to-End Testing (CEET):
 - 1) Signal are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.
 - 7. Restore to condition prior to testing.
 - 8. Submit Manufacturer's Certificate of Functional Compliance.
 - 9. Engineer approval of Manufacturer's Certificate of Functional Compliance is required.
- E. Documentation:
- 1. Provide records generated during Commissioning Phase of Project, including, but not limited to:
 - a. Training documentation.
 - b. Manufacturer's Certificate of Source Testing.
 - c. Manufacturer's Certificate of Installation Verification.
 - d. Manufacturer's Certificate of Functionality Compliance.
 - e. Daily logs of equipment/system testing identifying tests conducted and outcome.
 - f. Test forms and documentation.
 - g. Functional Testing results.
 - h. Logs of time spent by manufacturer's representatives performing services on the job site.
 - i. Equipment lubrication records.
 - j. Electrical phase, voltage, and amperage measurements.
 - k. Insulation resistance measurements.
 - l. Bearing temperature measurements.
 - m. Data sheets of control loop testing, including testing and calibration of instrumentation devices and setpoints.
 - n. Provide: 1 electronic copy in format specified by Owner and 3 hard copies organized in notebooks.
 - o. Store the data within 24 hours of the test or document creation in the project system.
 - p. Due date: Within 14 calendar days of Substantial Completion.
 - 2. Engineer approval of documentation is required.
- F. Owner Training:
- 1. Train Owner's staff on the operation and maintenance of the equipment/system.
 - a. Provide Owner staff with state regulatory agency approved training CEUs.
 - 2. Train on each topic of the approved Operation and Maintenance Manual.
 - a. Include classroom instruction and field demonstration with all necessary tools and test equipment.
 - 3. Training tailored to the skills and job classifications of the staff attending the classes (e.g., plant superintendent, treatment plant operator, maintenance technician, electrician, etc.).
 - 4. Training outcomes:
 - a. Owner's staff can safely operate, maintain, and repair the equipment/systems provided as recommended by the manufacturer.

5. Training plan:
 - a. CC shall meet with Engineer and Owner's designated training coordinator to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 120 calendar days prior to commissioning of equipment/system.
 - b. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
 - c. Conduct classroom training at location designated by Owner.
 - d. Scope and sequence:
 - 1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees.
 - a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
 - 2) If multiple classes are needed to meet the training objectives, they shall be included in the training plan.
6. Owner Training Schedule:
 - a. Schedule Owner's staff training within the constraints of their workloads.
 - 1) Those who will participate in this training have existing full-time work assignments, and training is an additional assigned work task, therefore, scheduling is imperative.
 - 2) Owner staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
 - 3) Maximum training hours per week: 8.
 - 4) Days available for training:
 - a) Wednesday is preferable.
 - b) Other days may be available upon request.
 - b. Training scheduling coordination:
 - 1) CC is responsible for the following:
 - a) Coordinate schedule for training periods with the Owner's personnel and manufacturer's representatives (instructors).
 - 2) Complete Owner Training no sooner than 15 calendar days prior to Functional Testing of each system.
 - c. Class logistics:
 - 1) Delivery time minimum: 2 hours.
 - 2) Delivery time maximum: 4 hours.
 - 3) Class agenda:
 - a) Refreshment break: One 10-minute break.
 - b) Meal break: One 45-minute break, unless otherwise specified.
 - c) Schedule refreshment breaks and meal breaks to meet the class needs and Owner work rules.
 - 4) Schedule specific sessions:
 - a) Minimum of 30 days in advance to allow Owner staffing arrangements to take place.
 - b) At the times requested by the Owner, within the period 7 a.m. to 7 p.m. Monday through Friday.
 - (1) Times scheduled will be at Owner's discretion.
 - c) Owner approval and confirmation required for session schedules.

- d) Provide minimum of 2 sessions for each class unless otherwise noted.
 - (1) The purpose of having multiple sessions on each class is to accommodate the attendance of as many Owner personnel working different shifts as possible.
 - e) A maximum of 1 session per day for each class.
 - d. Number of students:
 - 1) Estimated class size maximum: 5 staff.
 - 2) Engineer will confirm the headcount 1 week prior to the class so that the instructor can provide the correct number of training aids for students.
- 7. Submittals:
 - a. Submit Training Plan Schedule 120 calendar days before the first scheduled training session, including, but not limited to, lesson plans, participant materials, instructor's resumes, and training delivery schedules.
 - b. Submit training documentation, including the following:
 - 1) Training plan:
 - a) Training modules.
 - b) Scope and sequence statement.
 - c) Contact information for manufacturer's instructors. including name, phone, and e-mail address.
 - d) Instructor qualifications.
 - 2) Training program schedule:
 - a) Format: Bar chart:
 - (1) Include in the Project Progress Schedule.
 - b) Contents:
 - (1) Training modules and classes.
- 8. Lesson plans:
 - a. Divide training into discrete modules appropriate for the equipment and trades.
 - b. State performance-based learning objectives in terms of what the trainees will be able to do at the end of the lesson.
 - c. Define student conditions of performance and criteria for evaluating instructional success.
 - d. Minimum requirements:
 - 1) Hands-on demonstrations planned for the instructions.
 - 2) Cross-reference training aids.
 - 3) Planned training strategies such as whiteboard work, instructor questions, and discussion points or other planned classroom or field strategies.
 - 4) Attach handouts cross-referenced by section or topic in the lesson plan.
 - 5) Indicate duration of outlined training segments.
 - e. Provide instruction lesson plans for each trade:
 - 1) Detailed component description:
 - a) Identify each component function and describe in detail.
 - b) Identify equipment's mechanical, electrical, and electronic components and features.
 - c) Where applicable, group relative components into subsystems.

- d) Identify and describe in detail equipment safety features, permissive and controls interlocks.
- 2) Equipment operation:
 - a) Describe equipment's operating (process) function and system theory.
 - b) Describe equipment's fundamental operating principles and dynamics.
 - c) Identify support equipment associated with the operation of subject equipment.
 - d) Detail the relationship of each piece of equipment or component to the subsystems, systems, and process.
 - e) Cite hazards associated with the operations, exposure to chemicals associated with the component, or the waste stream handled by the component.
 - f) Specify appropriate safety precautions, equipment, and procedures to eliminate, reduce, or overcome hazards.
- 3) Define Preventative Maintenance (PM) inspection procedures required on equipment in operation, spot potential trouble symptoms (anticipate breakdowns), and forecast maintenance requirements (predictive maintenance).
 - a) Review preventive maintenance frequency and task analysis table.
- 4) Define equipment Corrective Maintenance (CM) troubleshooting:
 - a) Describe recommended equipment preparation requirements as they relate to specific craft problems.
 - b) Identify and describe the use of any special tools required for maintenance of the equipment as they relate to specific craft problems.
 - c) Provide component specific troubleshooting checklists as they relate to specific craft problems.
 - d) Describe component removal/installation and disassembly/assembly procedures for specific craft repairs.
 - e) Perform at least 2 hands-on demonstrations of common corrective maintenance repairs.
- 5) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
- 9. Training instruction format:
 - a. Training for operations and maintenance personnel shall be provided as one entity.
 - b. Instructors shall apply adult education best practices, emphasizing learner participation and activity.
 - c. Lecturing should be less than 30 percent of class time.
 - d. Training delivery may include problem solving, question/answer, hands-on instruction, practice, evaluation/feedback tools, and lecture to support training objectives.
 - e. Conduct hands-on instruction according to the following descriptions:
 - 1) Present hands-on demonstrations of at least the following tasks:
 - a) Proper start-up, shutdown, and normal and alternative operating strategies.
 - b) Common corrective maintenance repairs for each group.

- c) Recommended procedures to check/test equipment/system following a corrective maintenance repair.
 - d) Preventative maintenance points.
 - e) Calibration, if applicable.
 - 2) Use tools and equipment provided by manufacturer to conduct the demonstrations.
 - a) Submit requests for supplemental assistance and facilities with the Contractor's proposed lesson plans.
 - 3) Contractor remains responsible for equipment disassembly or assembly during hands-on training situations involving equipment disassembly or assembly by Owner's personnel.
 - f. Training aids:
 - 1) Instructors shall provide needed audio-visual devices such equipment (televisions, video recorder/player, computer, projectors, screens, easels, etc.), models, charts, etc., for each class.
 - 2) Instructor to confirm with Engineer in advance of each class that the classroom will be appropriate for the types of audiovisual equipment to be employed.
10. Training sessions:
- a. Provide training sessions for equipment/system as specified in the individual equipment/system section.
 - b. Include the following information in the agenda:
 - 1) Instructor name.
 - 2) Listing of subjects to be discussed.
 - 3) Time estimated for each subject.
 - 4) Allocation of time for Owner staff to ask questions and discuss the subject matter.
 - 5) List of documentation to be used or provided to support training.
 - c. Owner may request that particular subjects be emphasized, and the agenda be adjusted to accommodate these requests.
 - d. Digitally record audio and video of each training session.
 - 1) Include classroom and field instruction with question and answering periods.
 - 2) Engineer approval required for producer of video materials from one of the following options:
 - a) Qualified, professional video production company or individual.
 - 3) Record in digital format and recording shall become property of the Owner with exclusive rights.
 - a) No video recording agreements will be entered into by the Owner.
 - 4) Media:
 - a) Video quality shall be 720p HD or greater in MPG, AVCHD, AVI, or MP4 format.
 - b) Digital color video format.
 - c) Provide audio portion of the composite CD sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
 - d) Identification: On each copy provide a label with the following information:
 - (1) Name of training.
 - (2) Date video was recorded.
 - e) Display continuous running time.

- f) At start of each video recording, record training class name, date, and instructor's name.
 - g) Provide audio quality that is not degraded during the recording of the field sessions due to background noise, space, distance or other factors.
 - 5) Contractor shall provide a written release from all claims to the recorded training material produced, if required.
 - e. Distribute copies of the agenda to each student at the beginning of each training class.
 - f. Trainees will keep training materials and documentation after the session.
 - g. Distribute Training Evaluation Form following each training session.
 - 1) Training Evaluation Form is included in this Section.
 - 2) Return completed Training Evaluation Forms to Owner's designated training coordinator immediately after session is completed.
 - 3) Revise training sessions judged "Unsatisfactory" by a majority of attendees.
 - a) Conduct training sessions again until a satisfactory rating is achieved.
11. Engineer approval of Owner Training is required.

1.08 START-UP PHASE

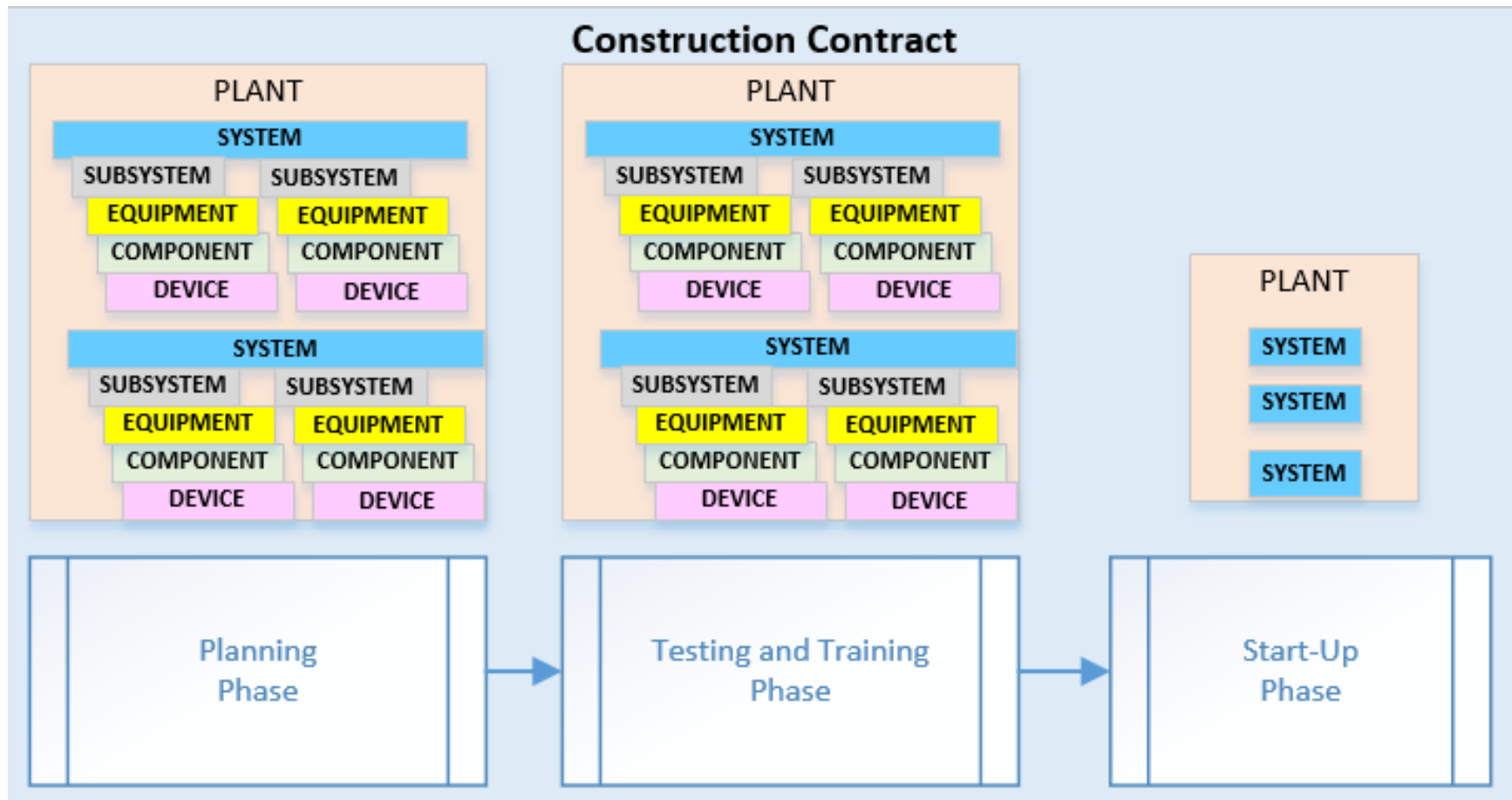
- A. Overview of Start-Up Phase:
 - 1. General:
 - a. Confirm reliability requirements.
 - b. Confirm regulatory compliance with drinking water standards.
- B. Start-Up Period:
 - 1. Contractor responsibilities:
 - a. Support Owner to operate the Work.
 - 2. Owner responsibilities:
 - a. Owner to operate the Work.
 - b. Owner-provided services, equipment, and/or materials to be as specified in Section 01_11_00 - Summary of Work.
 - c. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
 - 3. Prerequisites:
 - a. Engineer approval of Testing and Training Phase.
 - 4. Witnessed.
 - 5. Duration: 14 days.
 - 6. Engineer approval of Start-Up Period is required to achieve substantial completion.

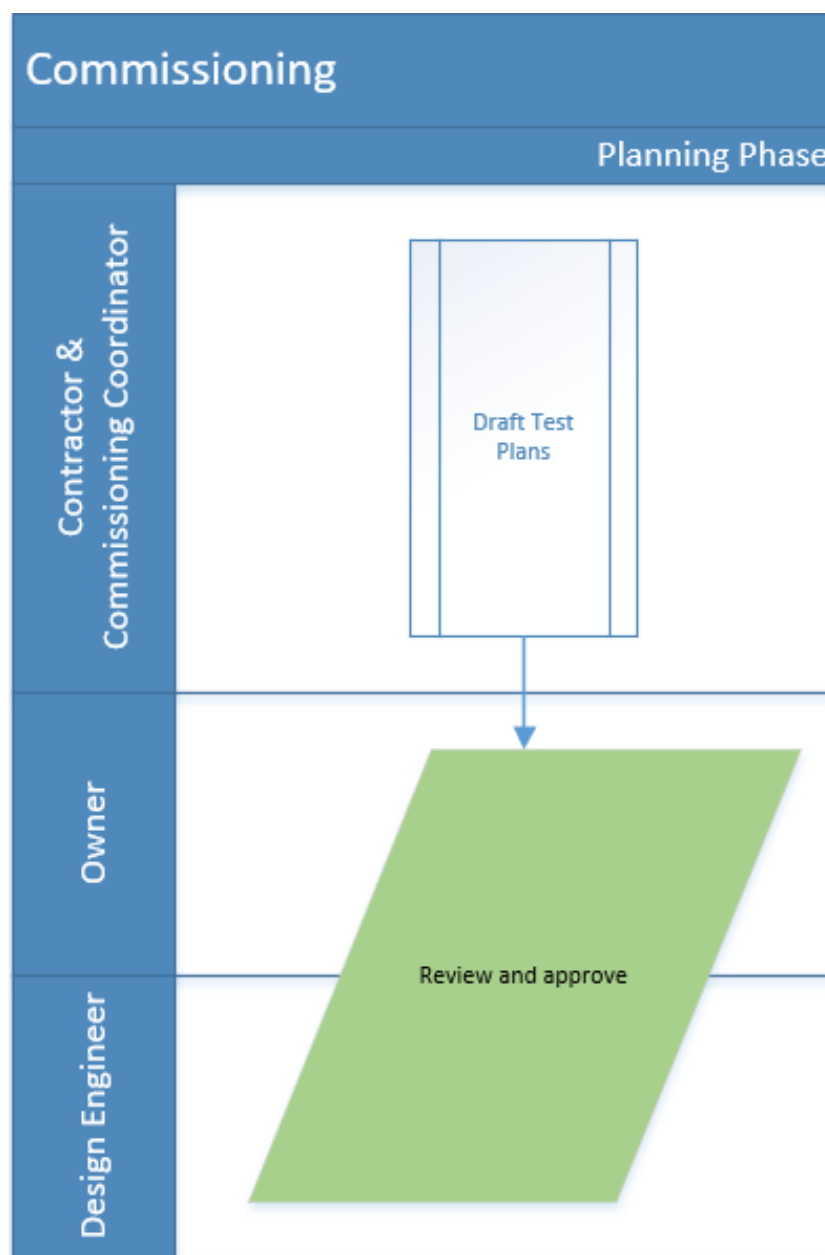
PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - COMMISSIONING FLOWCHARTS

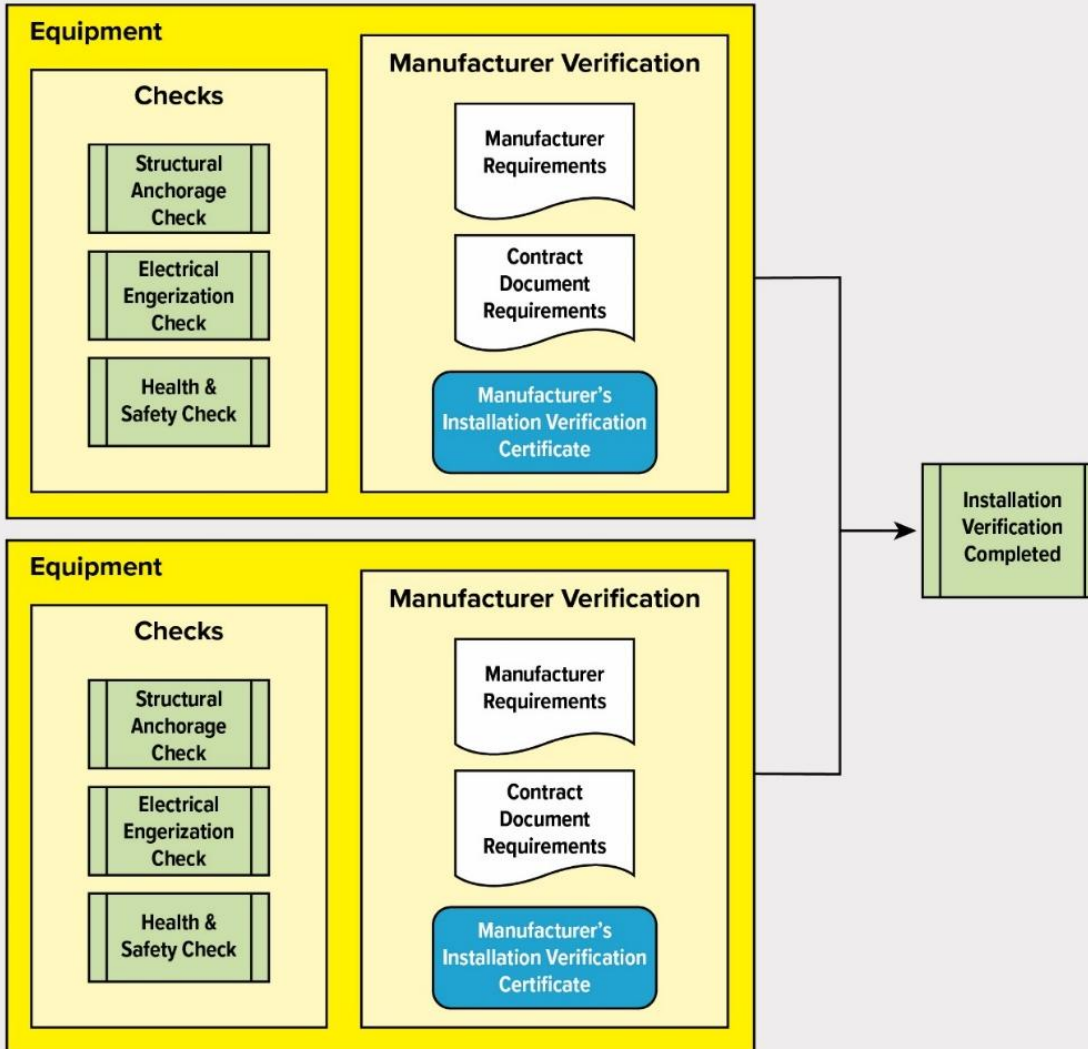




TESTING AND TRAINING PHASE

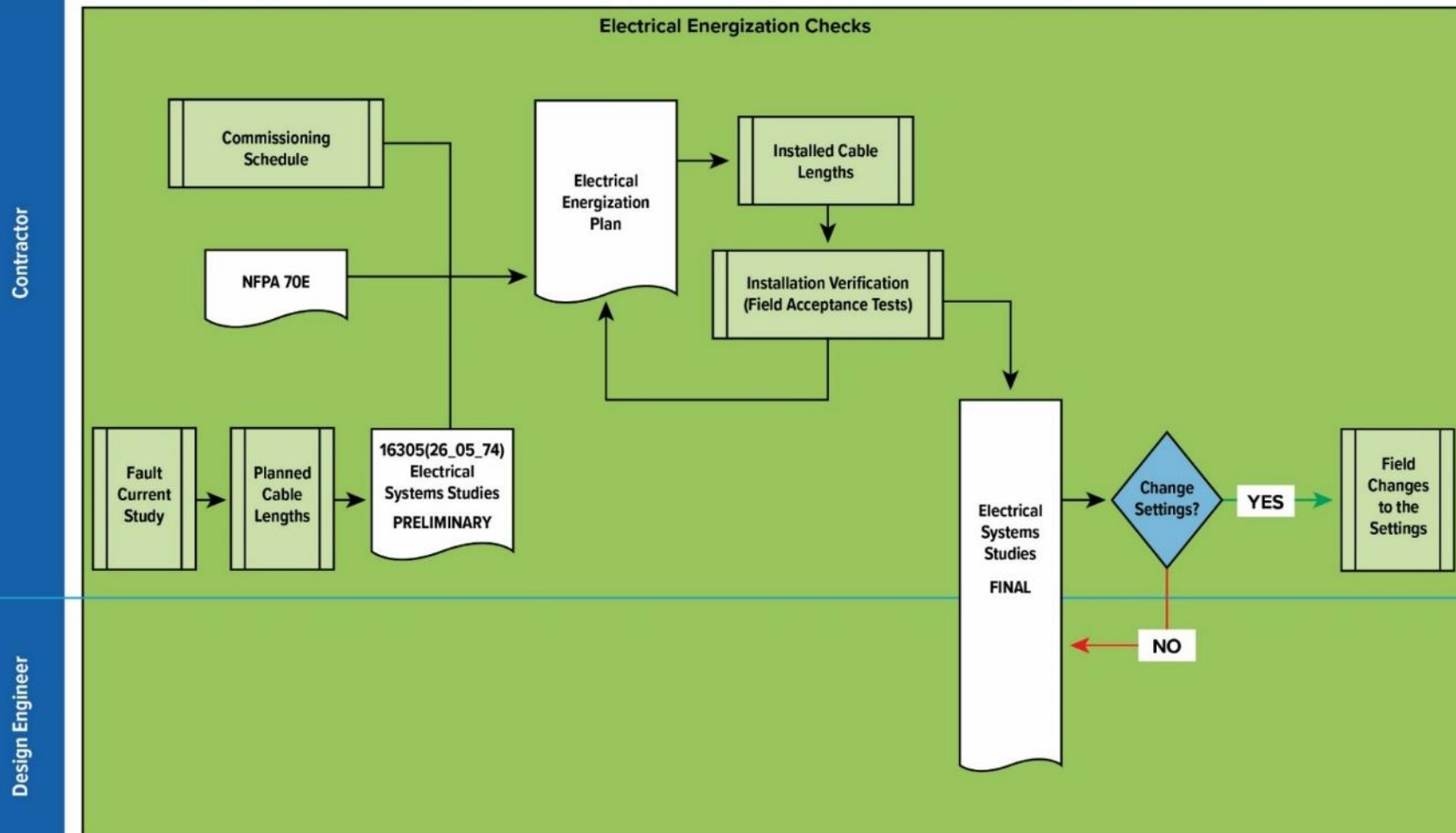
Installation Verification

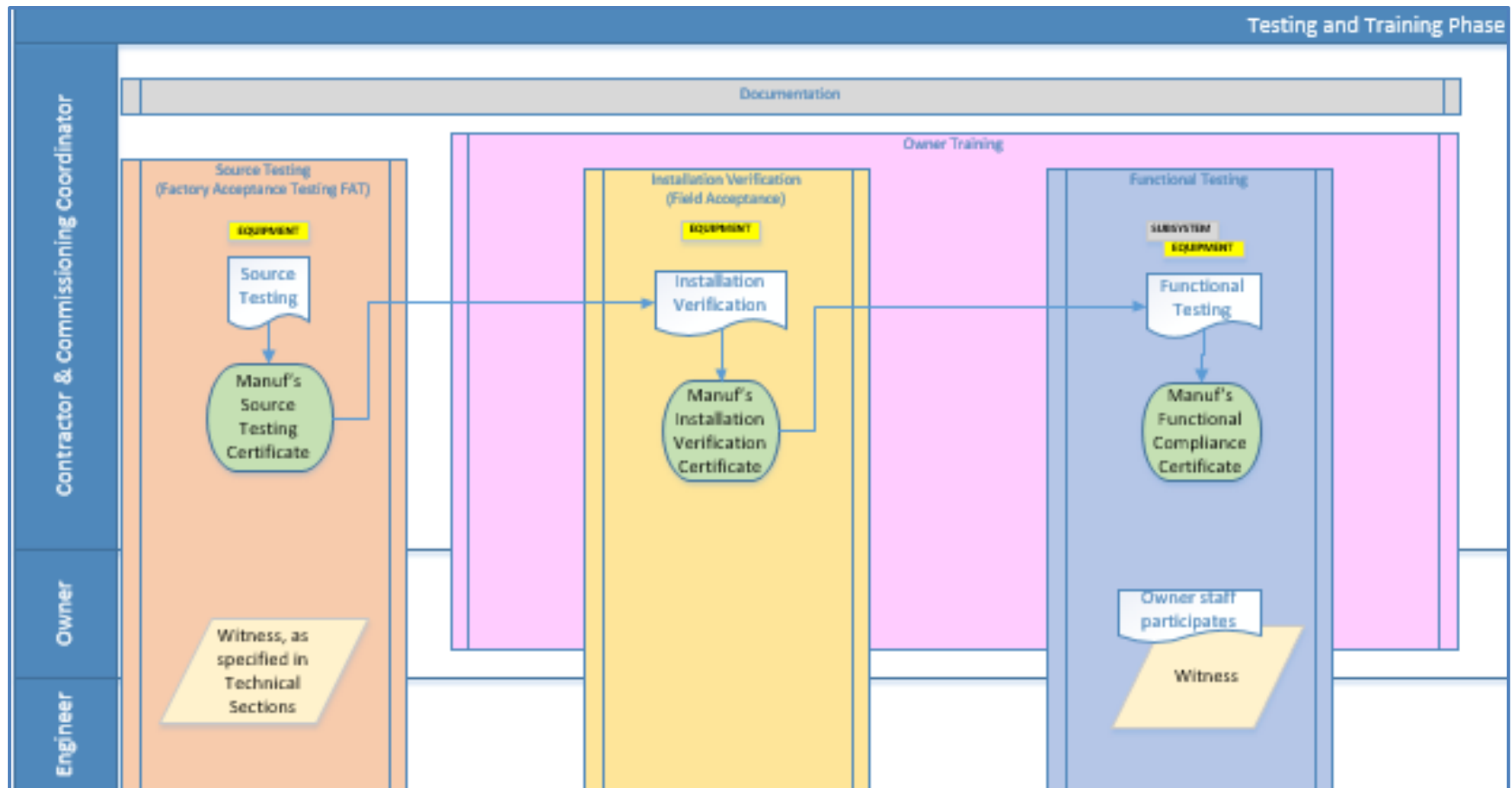
Contractor & Commissioning Coordinator

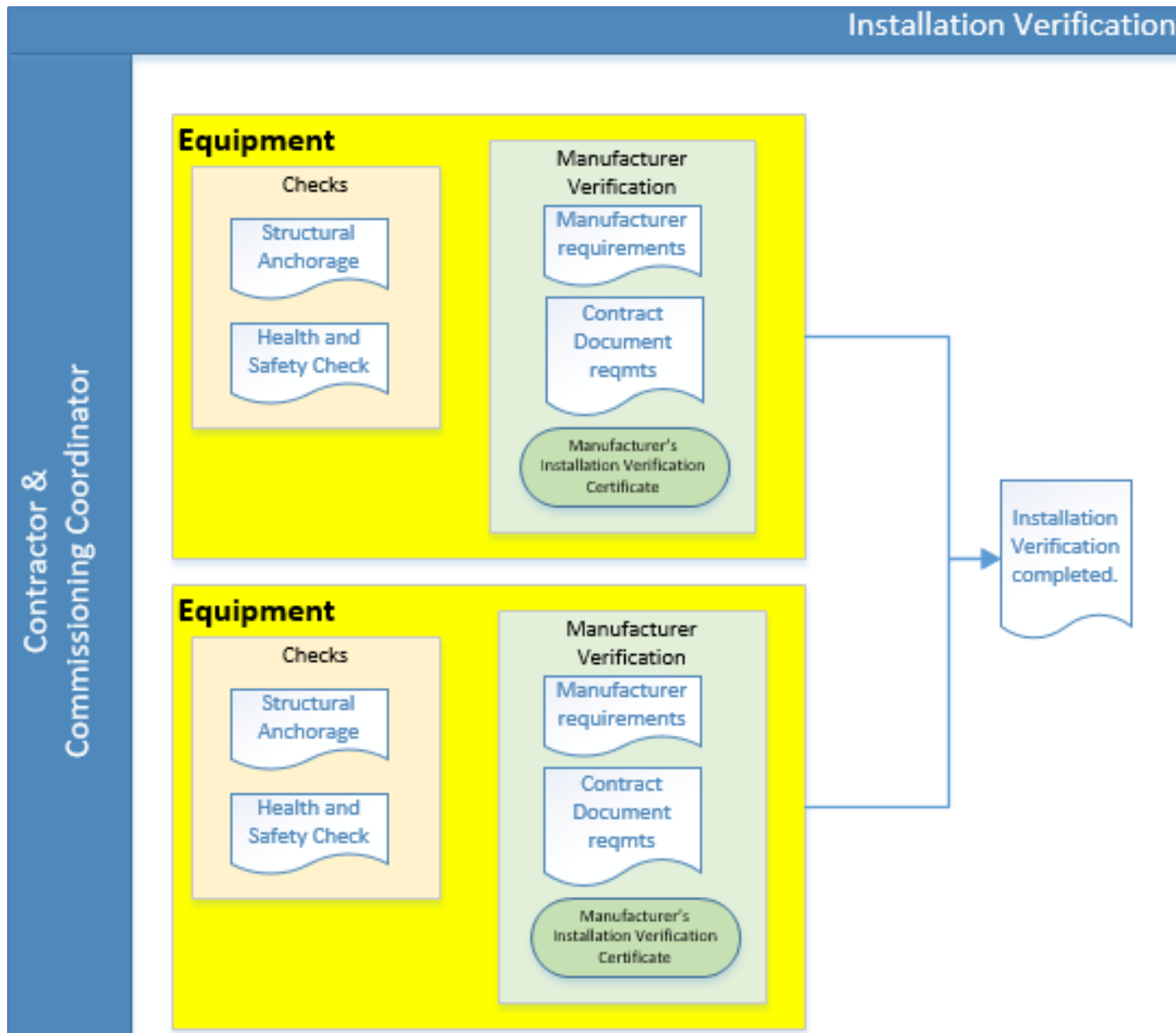


TESTING AND TRAINING PHASE - Installation Verification

Electrical Energization Checks



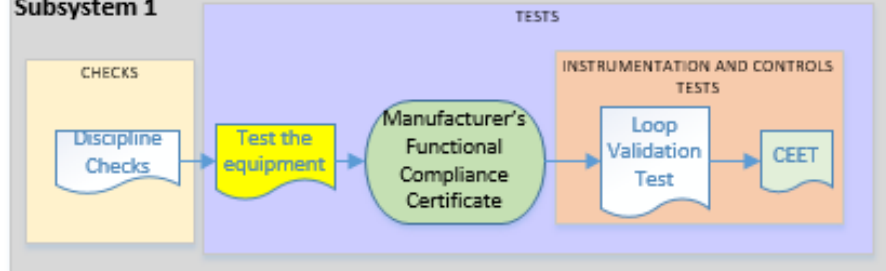




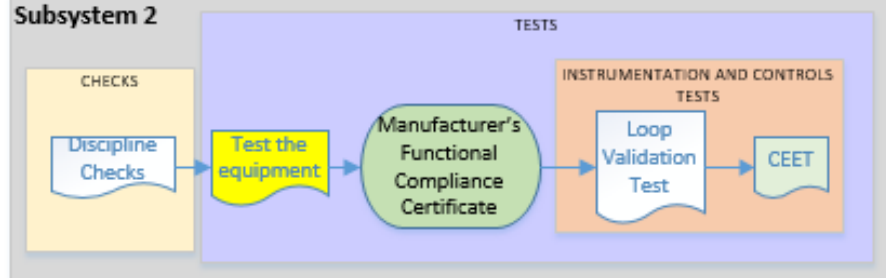
Functional Testing

Contractor &
Commissioning Coordinator

Subsystem 1



Subsystem 2



Complete End-to-End Testing (CEET) - Signals are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.



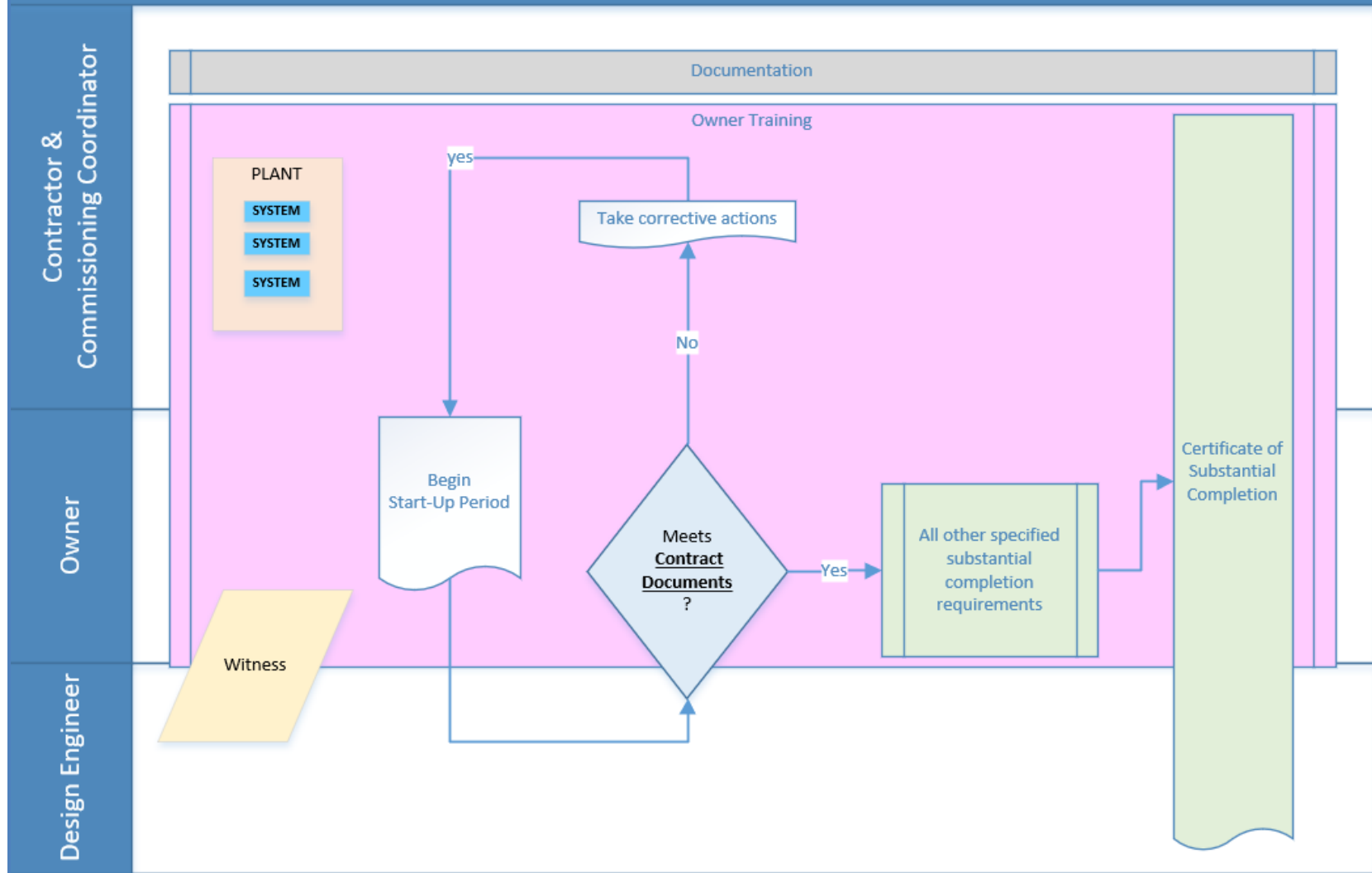
Owner

Design
Engineer

Witness

Commissioning

Start-Up Phase



ATTACHMENT B - MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

Comments: _____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20 _____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

(Authorized Signature)

If applicable, Witness Name (*print*): _____

(Witness Signature)

ATTACHMENT C - MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify the installation of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:

1. Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT D - MANUFACTURER’S CERTIFICATE OF FUNCTIONAL COMPLIANCE

MANUFACTURER'S CERTIFICATE OF FUNCTIONAL COMPLIANCE

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify the Functional Testing of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:

1. Attach test results with collected data and test report.
2. Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name (*print*): _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

WITNESSES:

By Owner's Authorized Representative: _____
(Authorized Signature)

By Engineer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT E - TRAINING EVALUATION FORM

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: _____

VENDOR/MANUFACTURER: _____

DATE: _____ NAME OF REPRESENTATIVE: _____

- | | | | | |
|--|--------------|----------------|----|-----|
| 1. Was representative prepared? | Acceptable | Unacceptable | or | N/A |
| 2. Was an overview description presented? | Acceptable | Unacceptable | or | N/A |
| 3. Were specific details presented for system components? | Acceptable | Unacceptable | or | N/A |
| 4. Were alarm and shutdown conditions clearly presented? | Acceptable | Unacceptable | or | N/A |
| 5. Were step-by-step procedures for starting, stopping, and troubleshooting presented? | Acceptable | Unacceptable | or | N/A |
| 6. Were routine/preventative maintenance items clearly identified? | Acceptable | Unacceptable | or | N/A |
| 7. Was the lubrication schedule (if any) discussed? | Acceptable | Unacceptable | or | N/A |
| 8. Was the representative able to answer all questions? | Acceptable | Unacceptable | or | N/A |
| 9. Did the representative agree to research and answer unanswered questions? | Acceptable | Unacceptable | or | N/A |
| 10. Comments: _____ | | | | |
| _____ | | | | |
| _____ | | | | |
| _____ | | | | |
| 11. Overall Rating | Satisfactory | Unsatisfactory | | |

Note:

Sessions judged "Unsatisfactory" by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

ATTACHMENT F - COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
Source Testing				
	Source Testing	Witnessed as specified in the Technical Sections.	Lead	Witnessed as specified in the Technical Sections. Review
	Manufacturer's Certificate of Source Testing	No Action	Lead	Review
Installation Verification				
	Structural Anchorage Check	Witness	Lead	Review
	Health and Safety Check	Witness	Lead	Review
	Manufacturer Requirements Verification	No Action	Lead	Review
	Contract Documents Verification	No Action	Lead	Review
	Manufacturer's Certificate of Installation Verification	No Action	Lead	Review
Functional Testing				
	Checks	Witness	Lead	Witness, Review
	Tests	Witness	Lead	Witness, Review
	Manufacturer's Certificate of Functional Compliance	No Action	Lead	Witness, Review
System Testing				
	System Testing	Witness	Lead	Witness, Review
Start-Up Phase				
	Start-Up	Lead	Support	Witness, Review
Legend: Lead: Primarily responsible for organization, coordination, and execution of task work product or result. Support: Assist the lead with organization, coordination, and execution of task work product or result. Witness: Observe and document completion of task work product or result. No Action: Limited or no involvement. Review: Approve for compliance with Contract Documents or reject.				

ATTACHMENT G - FUNCTIONAL TESTING REQUIREMENTS

FUNCTIONAL TESTING REQUIREMENTS

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
Flash Mix System		1	2	Test Water	Contractor
	Flash Mix Pump				
Equalization Basin					Contractor
	Equalization Pumps	1	2		
Recycle Wet Well					Contractor
	Recycle Pumps	1	2		
Irrigation Pump Station					Contractor
	Irrigation Pumps	1	2		
Membrane Filtration					Contractor
	Membrane Supply Pumps	1	2		
	Membrane System	Per MSS Agreement Documents	Per MSS Agreement Documents		
Chemical Feed Systems (Storage, Metering, etc.)		1	2	Test Water/Chemical	Contractor
	Primary Coagulant				
	Sodium Hypochlorite				
	Sulfuric Acid				
	Sodium Bisulfite				
	Caustic Soda				
	Citric Acid				
Entire Liquid Process Flow Stream		5	4	Re-circulated water from a potable water source	Contractor

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
	Flash Mix				
	Flocculation				
	Membrane System				
	GAC System				
	Equalization Basin				
	Thickening Basin				
	Recycle Wet Well				
	Irrigation Pump Station				
	Solids Holding Tank				
	Mechanical Dewatering	Per 46_76_21 and 41_12_20	Per 46_76_21 and 41_12_20		

A. Schedule delays:

1. Changes in the dates for Source Testing less than 30 days of the date provided in the latest approved Commissioning Schedule are considered delays.
2. Contractor is responsible for associated costs resulting from delays:
 - a. In person and/or virtual witnessing.
 - b. Travel costs and witness labor costs.
 - 1) Witness labor costs at \$250 per hour.

B. Repeat test costs:

1. Contractor is responsible for associated costs for repeat testing:
 - a. In person and/or virtual witnessing.
 - b. Travel costs and witness labor costs.
 - 1) Witness labor costs at \$250 per hour.

SECTION 01_78_24

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Preparation and submittal of manual with requirements to operate and maintain the equipment.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing:
 - 1. Submit draft operation and maintenance manuals prior to shipment of the equipment to the Site.
 - 2. Submit approved operation and maintenance manuals at least 30 days prior to Functional Testing and at least 60 days prior to Owner Training.
 - 3. Make final operation and maintenance manuals available at the Site for use by construction personnel.

1.03 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures and the Technical Sections.
- B. Draft operation and maintenance manuals:
 - 1. Quantity:
 - a. Electronic copy in portable document format (PDF) format.
- C. Final operation and maintenance manuals:
 - 1. Revised in accordance with the Owner's and Engineer's comments on the draft operation and maintenance manuals, and to include Functional Testing results and certificates.
 - 2. Quantity:
 - a. Electronic copy in PDF format.
- D. Spare parts list:
 - 1. Provide a consolidated spare part list required in accordance with the Technical Specifications.
 - 2. Engineer and Owner to review list prior to the Contractor's procurement of spare parts.
- E. Project operation and maintenance manual list: An Excel file log of manuals to be provided on the Project for tracking and review by the Owner and Engineer.

1.04 PREPARATION

- A. General requirements:
 - 1. Provide dimensions in English units.
 - 2. Assemble material, where possible, in the same order within each volume.
 - 3. Complete forms on computer; handwriting is not acceptable.
 - 4. Delete items or clearly mark out options not provided in the supplied equipment.
 - 5. Cover page shall include the following information:
 - a. Operation and maintenance manual.
 - b. Equipment name.
 - c. Specification Section number.
 - d. Equipment tag number s.
 - e. Owner's name.
 - f. Project number and name.
 - g. Date.
- B. Hard copy requirements:
 - 1. 3-ring D-ring binder with rigid covers.
 - a. Break into separate binders as needed to accommodate size.
 - 2. Utilize numbered tab sheets to organize information.
 - 3. Label the binder spine:
 - a. Equipment name.
 - b. Equipment tag number s.
 - c. Project name.
 - d. Owner's name.
 - 4. Provide original and clear text on reproducible non-colored paper:
 - a. Size: 8 1/2 by 11 inches.
 - b. Weight: 24 pounds.
 - 5. Drawings larger than 8 1/2 by 11 inches:
 - a. Fold drawings separately and place in envelope bound into the manual.
 - b. Label each drawing envelope on the outside regarding contents.
- C. Electronic requirements:
 - 1. File format:
 - a. Entire manual in PDF.
 - 1) Include text and drawing information.
 - 2) Provide a single PDF file.
 - 3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.).
 - a) Scanned images are not acceptable.
 - b) At file opening, display the entire cover page.
 - 4) Pagination and appearance to match hard copy.
 - 5) Ensure that page numbers are included on every page of the document.
 - 6) Text searchable throughout the entire document, including drawings.
 - 7) Bookmarks: As specified in Section 01_33_00 - Submittal Procedures.
 - 8) Thumbnails optimized for fast web viewing.
 - b. Drawing requirements:
 - 1) Provide electronic file with drawings in most current version of AutoCAD format.

- 2) White background.
 - 3) Shapes shall not degrade when closely zoomed.
 - 4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
2. Media:
 - a. USB flash drive.
 3. Label media with the following information:
 - a. Operation and maintenance manual.
 - b. Equipment name.
 - c. Specification Section number.
 - d. Equipment tag number.
 - e. Owner's name.
 - f. Project number and name.
 - g. Date.
 4. If multiple Submittals are made together, each Submittal must have its own subdirectory that is named and numbered based on the Submittal number.

1.05 CONTENTS

- A. Cover page.
- B. Table of Contents: General description of information provided within each tab section.
- C. Complete Attachment A - Equipment Summary Form.
- D. Completed motor data sheet as specified in Section 26_05_09 - Low Voltage Motors up to 500 Horsepower.
- E. Programming:
 1. Provide package control system annotated PLC code, if applicable.
 2. Contractor furnished programming.
- F. Description of system and components.
- G. Complete parts list for equipment, including, but not limited to, the following information:
 1. Catalog data: Generic title and identification number of each component part of equipment.
 2. Include bearing manufacturer, model, and ball or roller pass frequencies for every bearing.
 3. Availability.
 4. Service locations.
- H. Spare parts list:
 1. Recommended number of parts to be stored at the Site and special storage instructions.
- I. Engineering data:
 1. Complete set of 11-inch by 17-inch equipment drawings.
 2. Exploded view or plan and section views with detailed callouts.

3. Outline, cross-section, and assembly drawings.
 4. System drawings: Provide interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
 5. Packaged equipment system drawings: Provide instrumentation loop drawings, control schematic diagrams, interconnection and wiring diagrams, plan views, panel layouts, bill of materials, etc.
 6. System drawings and data sheets: Include drawings and data furnished by the Engineer and the Supplier; provide "as installed" version.
 7. Provide electrical and instrumentation schematic record drawings.
 8. Information required by the Technical Specifications.
- J. Description of equipment function, normal operating characteristics, and limiting conditions.
- K. Online resources.
- L. Telephone resources.
- M. Approved Submittals.
1. Markup with any field changes.
 2. Quality Control Submittals:
 - a. Source Testing and Functional Testing test reports and test data.
 - b. Manufacturer's certificates.
 - c. Performance curves.
- N. Start-up procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.
- O. Operating procedures:
1. Step-by-step instructions, including, but not limited to, the following:
 - a. Safety precautions and applicable safety data sheets.
 - b. Guidelines.
 - c. Other information as needed for safe system operation and maintenance.
- P. Preventative maintenance procedures:
1. Recommended steps and schedules for maintaining equipment.
 2. Troubleshooting.
- Q. Storage instructions.
- R. Lubrication information: Required lubricants and lubrication schedules.
- S. Overhaul instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
- T. Manufacturer's technical reference manuals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - EQUIPMENT SUMMARY FORM

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM: _____
2. MANUFACTURER: _____
3. EQUIPMENT TAG NUMBER(S): _____
4. LOCATION OF EQUIPMENT: _____
5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS): _____

6. NAMEPLATE DATA:

Horsepower: _____

Amperage: _____

Voltage: _____

Service Factor (S.F.): _____

Speed: _____

ENC Type: _____

Capacity: _____

Other: _____

7. MANUFACTURER'S LOCAL REPRESENTATIVE:

Name: _____

Address: _____

Telephone Number: _____

8. MAINTENANCE REQUIREMENTS:

Maintenance Operation	Frequency	Lubricant (if applicable)	Comments
(List each operation required. Refer to specific information in manufacturer's manual, if applicable)	(List required frequency of each maintenance operation)	(Refer by symbol to lubricant list as required)	

9. LUBRICANT LIST:

Reference Symbol	Conoco Phillips	Exxon/Mobil	BP/Amoco	Other (List)
(Symbols used in Item 8 above)	(List equivalent lubricants, as distributed by each manufacturer for the specific use recommended)			

10. SPARE PARTS (recommendations): _____

11. COMMENTS: _____

12. GENERAL INFORMATION:

Date Accepted:* _____

Expected Life:* _____

Project Name and Number: _____

Design Engineer: _____

13. WARRANTY:

Start Date: _____

Expiration Date: _____

Prorated: _____

SECTION 01_78_36
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Warranty and bonds requirements.

1.02 SUBMITTALS

- A. For each item of material or equipment furnished under the Contract:
 - 1. Submit manufacturer's warranty prior to fabrication and shipment of the item from the manufacturer's facility.
 - 2. Submit manufacturer's special warranty when specified.
- B. Provide consolidated warranties and bonds within 15 calendar days of Substantial Completion.
 - 1. Contents:
 - a. Organize warranty and bond documents:
 - 1) Include Table of Contents organized by Specification Section number and the name of the product or work item.
 - b. Include each required warranty and bond in proper form, with full information, certified by manufacturer as required, and properly executed by Contractor, or subcontractor, supplier, or manufacturer.
 - c. Provide name, address, phone number, and point of contact of manufacturer, supplier, and installer, as applicable.
 - 2. Hardcopy format:
 - a. Submit 2 copies.
 - b. Assemble in 3 D-side ring binders with durable cover.
 - c. Identify each binder on the front and spine with typed or printed title "Warranties and Bonds"; Project Name or Title, and the Name Address and Telephone Number of the Contractor.
 - 3. Electronic copy in PDF format:
 - a. Submit 1 copy.

1.03 OWNER'S RIGHTS

- A. Owner reserves the right to reject warranties.
- B. Owner reserves the right to refuse to accept Work for the project if the required warranties have not been provided.

1.04 RELATIONSHIP TO GENERAL WARRANTY AND CORRECTION PERIOD

- A. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, both Contractor's general warranty and the correction period requirements.
- B. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty, nor does such affect or limit Contractor's performance obligations under the correction period.

1.05 MANUFACTURER'S 1 YEAR WARRANTY MINIMUM REQUIREMENTS

- A. Written warranty issued by item's manufacturer.
- B. Project-specific information, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Contractor.
- C. Covers all costs associated with the correction of the defect, including, but not limited to, removal of defective parts, new parts, labor, and shipping.
- D. Provides a timely response to correct the defect.
 - 1. Manufacturer shall provide, in a timely fashion, temporary equipment as necessary to replace warranted items requiring repair or replacement, when warranted items are in use and are critical to the treatment process, as defined by Owner.
- E. Warranty commence running on the date of substantial completion.
 - 1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of warranty period.
- F. Duration of warranty: 1 year.

1.06 MANUFACTURER'S SPECIAL WARRANTY

- A. Manufacturer's special warranty is a written warranty published by the manufacturer which includes the requirements as specified in the Technical Section.
 - 1. Project-specific information and requirements.
 - 2. Properly executed by product manufacturer.
 - 3. Expressly states that its provisions are for the benefit of the Contractor or Owner.
 - 4. Manufacturer's special warranties commence on the date that the associated item is certified by Engineer as substantially complete.

1.07 WARRANTY WORK

- A. Contractor's responsibilities:
 - 1. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the product, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

- B. Replacement cost:
 - 1. Upon determination that work covered by warranty has failed, replace or rebuild the work to an acceptable condition complying with requirement of the Contract Documents.
 - a. Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether Owner has benefited from the use of the work through a portion of its anticipated useful service life.
- C. Related damages and losses:
 - 1. When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.
- D. Owner's recourse:
 - 1. Written warranties are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitation on time in which Owner can enforce such other duties, obligations, rights, or remedies.
- E. Reinstatement of warranty:
 - 1. When work covered by a warranty has failed and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
 - a. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

1.08 IMPLIED WARRANTIES

- A. Warranty of title and intellectual rights:
 - 1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
 - 2. Provisions on intellectual rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.
- B. Implied warranties: Duration in accordance with Laws and Regulations.

1.09 BONDS

- A. Equipment bond and other bond requirements as specified in the Technical Sections.
- B. Bonds commence running on the date of substantial completion.
 - 1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of bond period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01_81_50

DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Design criteria for use in the selection of equipment and appurtenances specified in Technical Sections of these Specifications and indicated on the Drawings.
 - 2. Criteria for design of systems, components and equipment fabricated off site and shipped to the Work for installation.
 - 3. Criteria for design of anchors to connect equipment and appurtenances to supports and structures.
- B. The criteria in this Section apply throughout the Work, unless additional criteria, or more restrictive criteria, are indicated.
 - 1. Additional criteria and requirements relevant to specific locations, specific materials, and specific equipment are indicated on the Drawings and in the Technical Sections.

1.02 REFERENCES

- A. American Society of Civil Engineers (ASCE):
 - 1. 7-22 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures. (ASCE 7).
- B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
 - 1. ASHRAE Fundamentals Handbook.
- C. International Code Council (ICC):
 - 1. International Energy Conservation Code (IECC).
 - 2. International Plumbing Code (IPC).
- D. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA):
 - 1. Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd edition 2008.

PART 2 PRODUCTS

2.01 DESIGN CRITERIA - SITE INFORMATION

- A. Site name: Signal Hill Water Treatment Plant.
 - 1. Street address: As specified in Section 01_11_00 - Summary of Work.
 - a. Coordinates (approximate): Latitude 40.73865; Longitude -111.441723.
 - 2. Site elevation (approximate):
 - a. 7,044 feet.

3. Groundwater elevation:
 - a. See Project geotechnical reports, listed in Document 00_73_00 - Supplementary Conditions, for information.
 - b. For design of buried and partially buried construction:
 - 1) Groundwater is expected to be below the level of construction.

2.02 DESIGN CRITERIA - REGULATORY REQUIREMENTS

- A. Requirements of authorities having jurisdiction over the Project are included in Section 01_41_00 - Regulatory Requirements.

2.03 DESIGN CRITERIA - OPERATING ENVIRONMENT

- A. Drawings and Technical Sections include additional criteria and requirements relevant to specific locations, materials, and equipment.
- B. Outdoor conditions:
 1. IECC: Climate: Zone Summit County (6B).
 2. ASHRAE site climatic data location: Heber Valley, WMO #720565.
 3. Temperature criteria: As specified in the following Table: Design Temperatures - Outdoor Criteria in Accordance with ASHRAE Fundamentals Handbook.

Table: Design Temperatures - Outdoor Criteria in Accordance with ASHRAE Fundamentals Handbook	
Condition	Criteria
Hottest Month DB Range:	39.6 degrees Fahrenheit.
Winter:	At or above this temperature 99.6 percent of the time: -4.7 degrees Fahrenheit dry-bulb.
Summer:	At or above this temperature 0.4 percent of the time: 95 degrees Fahrenheit dry-bulb.

4. Rainfall intensity:
 - a. Reference: International Plumbing Code (IPC):
 - 1) 2.63 inches per hour (60-minute precipitation intensity).
 - 2) 6.3 inches per hour (15-minute precipitation intensity).
- C. Indoor conditions:
 1. HVAC:
 - a. As specified in Section 23_09_13 - Instrumentation and Control Devices for HVAC.

2.04 DESIGN CRITERIA - STRUCTURAL

- A. General:
 1. Criteria for structural design of:
 - a. Equipment at locations subject to seismic events.
 - b. Equipment exposed to outdoor environments.
 - c. Equipment supports and bracing, and anchorage of such items to building and non-building structures.
 - d. Structures provided for the Work through Delegated Design.

- e. Manufactured and prefabricated structures, and anchorage of such structures to foundations or other supporting elements.
 - 2. General Structural design criteria used by the Engineer of record and required by the building code to be indicated on the Drawings are included on the Contract Drawing titled General Structural Notes. Specific Structural design criteria that are specific to individual structures are located in the Design Criteria notes on the Drawings for each structure.
- B. Delegated Design:
- 1. As specified in Section 01_35_73 - Delegated Design Procedures.
 - 2. Structural engineering design shall be performed by a Professional Civil or Structural Engineer licensed in the State of Utah. Calculations and drawings shall bear the signature and seal of the engineer overseeing the work on them.
- C. Structure risk category:
- 1. Develop design loads and provide detailing in accordance with the provisions of ASCE 7 and the building code specified in Section 01_41_00 - Regulatory Requirements, based on Risk Category IV.
- D. Seismic loads:
- 1. Seismic design parameters: Basic parameters - ASCE 7:
 - a. Ground motion MCE_R , 5 percent damped:
 - 1) Short periods, $S_s = 0.54$ g.
 - 2) 1 second period, $S_1 = 0.17$ g.
 - b. Peak ground acceleration, MCE_G :
 - 1) Peak ground acceleration, $PGA_M = 0.25$ g.
 - c. Mapped long-period transition period:
 - 1) $TL = 8$ seconds.
 - d. Multi-Period Design Spectrum: See Appendix A.
 - 2. Structures - General:
 - a. Seismic Design Category (SDC): D.
 - b. Structure response modification coefficient, R :
 - 1) In accordance with ASCE 7 and the requirements of the Technical Sections.
 - 3. Structures - Tanks and vessels.
 - a. Includes: Tank structures, tank supports, and anchorage to structures or foundations.
 - b. Liquid storage structures (e.g., basins and tanks).
 - 1) Include impulsive and convective (sloshing) effects.
 - 2) Component response modification factor - impulsive effects, R_i : In accordance with ASCE 7, Table 15.4-2.
 - 3) Component response modification factor - convective effects, $R_c = 1.0$.
 - c. Dry material storage structures (e.g., silos, hoppers):
 - 1) Include effects of stored materials.
 - 2) Component response modification factor - impulsive effects, R_i : In accordance with ASCE 7, Table 15.4-2.
 - 4. Non-structural components - General:
 - a. Includes:
 - 1) Mechanical and electrical equipment; anchorage of equipment to structures or supports; design of supports; and anchorage of supports to structures or foundations.

- 2) Distribution systems associated with mechanical and electrical equipment such as piping, ductwork, conduits, cable trays, raceways, bus ducts, and similar items; anchorage of such systems to supports and structures; and bracing or such systems.
- b. Seismic design requirements for non-structural components are based on the Seismic Design Category (SDC) of the structure or facility where the equipment is installed.
- c. Design components, component anchorage, and component connections to piping and utilities in accordance with the requirements of ASCE 7, Table 13.2-1.
- d. Component amplification factor (a_p), response factor (R_p), and overstrength factor for anchorage to concrete (Ω_o):
 - 1) Mechanical and electrical components and systems: In accordance with ASCE 7, Table 13.6-1, unless otherwise indicated in the Technical Sections for these items.
 - 2) Architectural components and systems: In accordance with ASCE 7, Table 13.6-1, unless otherwise indicated in the Technical Sections for these items.
- e. Component importance factor, I_p :
 - 1) In accordance with the following Table: Component Importance Factor for Seismic Design, I_p .
 - 2) For items not listed in Table: Component Importance Factor for Seismic Design, I_p , designate importance factor in accordance with the provisions of ASCE 7, Chapter 13, and submit to the Engineer for review prior to developing calculations and details related to that component.

Table: Component Importance Factor for Seismic Design, I_p		
Structure Seismic Design Category	Components	I_p
All	Electrical: Items and distribution system components specified in Division 26 - Electrical.	1.5
All	Process Control and Instrumentation Systems: Components and distribution systems specified in Division 40 - Process Integration.	1.5
All	Fire protection: Components and distribution systems specified in Section 10_44_00 - Fire Protection Specialties.	1.5
All	Conveyance and distribution systems and supports for toxic, highly toxic, hazardous, or explosive substances as specified in Divisions 06 through 49.	1.5
All	Conveying equipment: Items specified in Division 14	1.0
All	Equipment and components specified in Divisions 11 through 49, <u>except</u> HVAC and plumbing components listed below.	1.5
All	Plumbing equipment specified in the following Sections: 22_42_01 - Plumbing Systems 22_45_17 - Emergency Eye/Face Wash and Shower Equipment	1.0

Table: Component Importance Factor for Seismic Design, I_p		
Structure Seismic Design Category	Components	I_p
All	HVAC equipment specified in the following Sections: 23_81_44 - Heat Pumps 23_75_34 - Makeup Air Unit 23_83_01 - Heating Units 23_34_01 - Fans	1.0
All	Other equipment not listed above.	1.0

5. Non-structural components: HVAC ductwork.
 - a. Component importance factor, I_p : Determine in accordance with ASCE 7, Section 15.4.1.1.
 - b. Seismic design category:
 - 1) See Table: Component Importance Factor for Seismic Design, I_p (preceding).
 - c. SMACNA seismic hazard level.
 - 1) Seismic hazard level for design of heating, ventilating, and air conditioning ductwork in accordance with SMACNA Seismic Restraint Manual:
 - a) SMACNA Seismic hazard level = Exempt.
- E. Wind loads:
1. Design structures and non-structural components that are exposed to wind to withstand design wind loads.
 - a. Reduction of wind loads based on shielding effects of surrounding structures or components is not allowed.
 - b. Design for wind loading is not required for non-structural components and for non-building structures located inside enclosed buildings.
 2. Design parameters:
 - a. Basic wind speed:
 - 1) 115 miles per hour (33 feet, 3 second gust).
 - b. Exposure category: C.
 - c. Topographic factor, K_{zt} : 1.0.
- F. Snow loads:
1. Design for snow loading is not required for non-structural components and for non-building structures located inside enclosed buildings.
 2. Design parameters:
 - a. Ground snow load: p_g = 210 pounds per square foot.
 - b. Exposure factor, minimum: I = 1.0.
 - c. Drifting:
 - 1) Consider effects of adjacent and nearby structures and equipment on drift loads.

- G. Rainfall loads:
 - 1. Determine rainfall loads using rainfall intensity specified in this Section and including effects of exposed surface slope, height above surface to discharge elevation, and deflection of ponded surfaces.
- H. Operational loads:
 - 1. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), surge or water hammer, and other load conditions.
 - 2. Design for loads indicated by the equipment manufacturer.
 - 3. Design for loads indicated in the Technical Sections for equipment and appurtenances.
- I. Serviceability considerations:
 - 1. Deflection, unless otherwise indicated on the Drawings, or specified:
 - a. Beam deflection as fraction of span:
 - 1) Walkways and platforms: Total load = $L/240$; live load = $L/360$.
 - 2) Equipment supports: $L/450$.

PART 3 EXECUTION

3.01 GENERAL

- A. Design approach and criteria in accordance with:
 - 1. Regulatory requirements, including, but not limited to, the building code specified in Section 01_41_00 - Regulatory Requirements.
 - 2. Reference standards and project-specific design criteria listed in this Section.
 - 3. Specific requirements for individual elements and components of the Work as specified in subsequent Technical Sections.
- B. In the event of conflicts between design criteria, contact Engineer for interpretation.
- C. Where Owner-Delegated Design is required by the Specifications, prepare and submit designs as specified in Section 01_35_73 - Delegated Design Procedures.

3.02 DELEGATED DESIGN

- A. Where Delegated Design is required by the Technical Sections, prepare and submit designs as specified in Section 01_35_73 - Delegated Design Procedures.
- B. Calculations:
 - 1. Where submittal of calculations is required:
 - a. Provide complete calculations, including sketches to illustrate the design concepts being evaluated, and details to fully describe proposed construction.
 - 2. Requirements for seismic design calculations will be waived for the following:
 - a. Furniture and storage racks 6 feet in height or less.
 - b. Moveable equipment.
 - c. Mechanical and electrical equipment and components located in structures designated as Seismic Design Category A or B.

- d. Mechanical and electrical equipment and components located in structures designated as Seismic Design Category C and where the component importance factor, I_p , is equal to 1.0.
 - 3. Requirements for wind design calculations will be waived for the following:
 - a. Equipment and components located inside structures, and away from the effects of wind loads.
- C. Shop Drawings:
 - 1. Describing components and manufacturer's requirements for connections.
 - a. Include details for connections of components to structures and supports.
 - b. Include details for anchoring bracing to structures where required.

3.03 DESIGN - ANCHORS FOR EQUIPMENT, COMPONENTS, AND BRACING

- A. General:
 - 1. Engineer's approval of anchor designs is required before placement of construction that supports or provides bracing for anchored equipment and components.
 - a. Prepare anchor designs after the Engineer's approval of the products and layout, and before placement of concrete or masonry that supports them.
 - 2. Adjust equipment pad sizes and add additional anchor confinement reinforcing to provide required strength at anchorage points between equipment and pad, and between pad and structure.
 - 3. Supports and bracing:
 - a. Design and install braces and anchors to transfer forces from equipment and components to the lateral force resisting system of the surrounding structure.
 - b. Anchor and brace piping, ductwork, and electrical distribution components so that lateral or vertical displacement does not result in damage to or failure of essential architectural, mechanical, or electrical equipment.
 - 1) Provide supplementary framing where required to transfer forces.
 - 2) Detail and locate braces and anchors to minimize differential movements between components and structure.
- B. Preparation:
 - 1. Obtain manufacturer's information:
 - a. Weight and dimensions of components.
 - b. Layout and location of anchors that connect to equipment base plates, sole plates, skids, or pads.
 - c. Sizes of holes for anchors that will be provided in equipment bases or support frames.
- C. Analysis and design:
 - 1. Perform and submit calculations to determine anchor designs at locations where equipment and equipment supports are connected to the supporting structure.
 - a. Indicate number, size, type, and material for anchors.
 - 2. In determining forces at locations where equipment is anchored to structures, include effects of:
 - a. Equipment self-weight and operating weight.
 - b. Location of equipment center of mass.

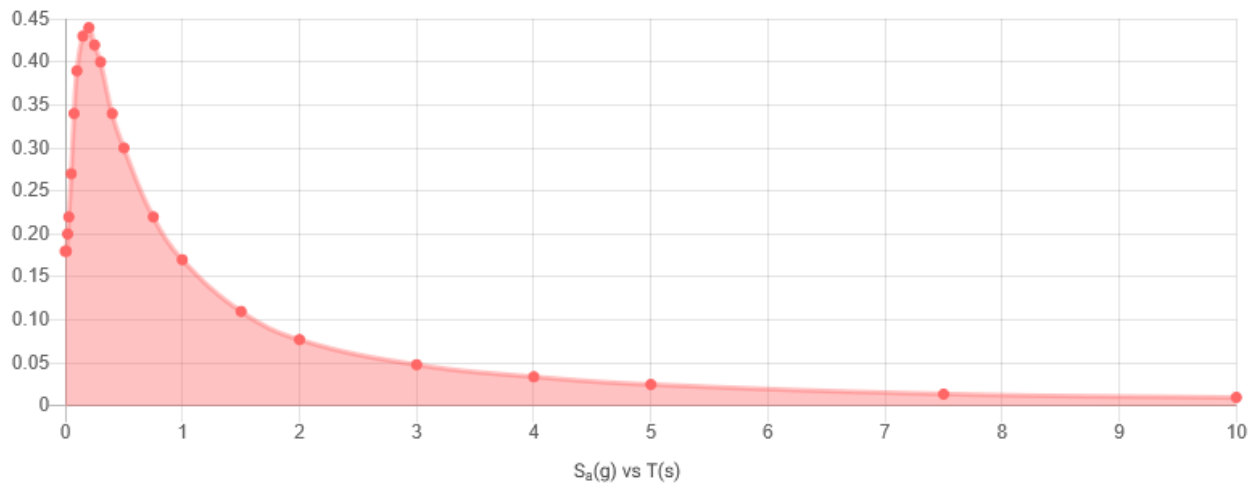
- c. Forces from equipment operation, including, but not limited to:
 - 1) Effects of internal contents, including weight and sloshing.
 - 2) Effects of thrust, surge, and water hammer where specified.
 - 3) Equipment reactions and operating torque.
 - 4) Equipment vibration.
 - 5) Thermal effects from equipment and from distribution systems connected to the equipment (piping, ducts, and electrical).
 - 6) Other load or displacement inducing conditions.
- d. Forces on equipment from loads specified in this Section.
 - 1) Include effects of wind, snow, and icing loads where applicable.
 - 2) Design for load combinations indicated in ASCE 7, unless otherwise specified or indicated on the Drawings.
 - 3) Seismic and wind loads: For equipment and tanks with weight that varies based on the volume of contained material, determine anchor forces to accommodate the full range of filled, partially filled, and empty conditions.
- 3. Determine forces and overturning moments at equipment supports and at locations where supports are anchored to structures.
 - a. Indicate shear force and associated axial force at each anchor.
- 4. Do not use friction to resist sliding resulting from seismic or wind forces.
 - a. Resist sliding only by direct application of sliding loads to fasteners as bearing, shear, tension, or compression forces.
- 5. Using combined shears and axial forces at each anchor, design anchors and anchor groups for ductile failure.
 - a. Ductile failure: Anchor yield before failure of base material, typically concrete or masonry, at the anchor.
- 6. Anchor selection:
 - a. Provide anchors type indicated on the Drawings.
 - b. Where anchors are not specifically indicated on the Drawings, select in accordance with the following:
 - 1) Anchors that resist seismic and wind forces:
 - a) Cast-in-place forged hex-head anchor bolt.
 - 2) Anchors loaded in sustained tension:
 - a) Cast-in-place forged hex-head anchor bolt.
 - 3) Anchors for reciprocating, vibrating, and rotating equipment:
 - a) Cast-in-place forged hex-head anchor bolt.
 - c. Do not use post-installed anchors, mechanical or adhesive, unless:
 - 1) Post-installed anchors are indicated on the Drawings, or
 - 2) Post-installed are approved by the Engineer prior to placement of the surrounding concrete or masonry.
 - d. Anchor diameter:
 - 1) Select diameter so that hole in base plate is not greater than 125 percent of the nominal diameter of the anchor, nor greater than the diameter of the anchor plus 1/4 inch.
- 7. Determine number, size, layout, and minimum effective embedment for anchors.
 - a. Layout includes anchor spacing and required distance(s) from anchor to edge(s) of supporting concrete or masonry.
 - b. Anchors in concrete: Design based on minimum specified 28-day compressive strength, f'_c , as follows, unless otherwise indicated on the Drawings for the Work area:
 - 1) Concrete placed for this Work: $f'_c = 4,500$ pounds per square inch.

- 2) Existing concrete in place prior to this Work: $f'_c = 3,000$ pounds per square inch.
- c. Anchors in masonry: Design based on minimum specified compressive strength, f'_m , as follows, unless otherwise indicated on the Drawings for the Work area:
 - 1) Concrete masonry placed for this Work: $f'_m = 2,000$ pounds per square inch.
- 8. Prepare Drawings showing construction details of anchor designs.
- 9. Submit design calculations and Drawings prior to placement of anchors, and of the structural elements to which they will connect.

END OF SECTION

ATTACHMENT A - MULTI-PERIOD DESIGN SPECTRUM

Period, T (s)	Design Spectral Acceleration, S _a (g)
0	0.18
0.01	0.18
0.02	0.2
0.03	0.22
0.05	0.27
0.075	0.34
0.1	0.39
0.15	0.43
0.2	0.44
0.25	0.42
0.3	0.4
0.4	0.34
0.5	0.3
0.75	0.22
1	0.17
1.5	0.11
2	0.077
3	0.048
4	0.034
5	0.025
7.5	0.014
10	0.0098



SECTION 26_05_00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Requirements for electrical:
 - a. Basic design and performance criteria.
 - b. Prescriptive requirements for common components.
 - c. Installation.
- B. Contract Drawings:
 - 1. Schematic diagrams:
 - a. Controls are shown as de-energized.
 - b. Add relays, where required, to provide necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.
 - c. Mount devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted.
 - 2. Plan drawings:
 - a. Electrical drawings show desired locations, arrangements, and components of the electrical Work in a diagrammatic manner.
 - b. Locations and sizes of equipment are approximate only.
 - 3. Installation details:
 - a. Contract Drawings include typical installation details the Contractor is to use to complete the electrical Work. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work and submit these details for review by the Engineer.
 - b. Not all typical installation details are referenced within the drawing set. Apply and use typical details where appropriate.

1.02 REFERENCES

- A. Abbreviations:
 - 1. FAT: Factory acceptance test that is also referred to as source test.
 - 2. ICSC: Instrumentation and controls subcontractor.
 - 3. PCIS: Process control and instrumentation system.
- B. Standards:
 - 1. American National Standards Institute (ANSI).
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).
 - 3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC).
 - 4. Underwriters Laboratories, Inc. (UL).

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. LCP: Local control panel: Operator interface panel that may contain pilot type control devices, operator interface devices, control relays, etc., and does not contain a PLC or RIO.
 - 2. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.
 - 3. Space: Portion of a switchgear, motor control center, panelboard, switchboard, or control panel that does not physically contain a device but is capable of accepting a device with no modifications to the equipment.
 - a. Furnish hardware to accommodate installation of future circuit breakers, instruments, relays, and controls.
 - b. Wire relay and circuit breaker control power and network connections to the compartment and provide terminations.
 - c. Space for future devices shall include:
 - 1) All necessary bus.
 - 2) Device supports and mounting equipment.
 - 3) Device connections to bus work.
 - 4) Wire troughs or raceway space.
 - 4. Spare: Portion of a switchgear, motor control center, panelboard, switchboard, or control panel that physically contains a device with no load connections to be made.
 - 5. Unequipped space: Portion of a switchgear, motor control center, panelboard, switchboard, or control panel that does not physically contain a device, standoff, bus, hardware, or other equipment.
 - 6. Vendor control panel (VCP): Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, OIT, HMI, etc.

1.04 DELEGATED DESIGN

- A. Requirements for Delegated Design are specified in the Technical Sections.

1.05 SUBMITTALS (NOT USED)

1.06 QUALITY ASSURANCE

- A. General:
 - 1. Furnish equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.
- B. Licenses:
 - 1. Provide the Owner's construction management team with daily updates of what area and room each licensed person is working in.
- C. Certifications:
 - 1. Furnish manufacturer or third-party certifications as specified in the Technical Specifications.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Shipping precautions:
 - 1. After completion of shop assembly and successful factory testing, pack equipment in protective crates, and enclose in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.
 - 2. Place dehumidifiers, when required, inside the polyethylene coverings.
 - 3. Skid-mount the equipment for final transport.
 - 4. Provide lifting rings for moving without removing protective covering.
 - 5. Display boxed weight on shipping tags together with instructions for unloading, transporting, storing, and handling at the jobsite.

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.09 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Loop drawings:
 - a. Provide electrical information required in the preparation of loop drawings, including, but not limited to:
 - 1) Conduit numbers and associated signal(s) contained within each conduit.
 - 2) Wire numbers.
 - 3) Equipment terminal numbers.
 - 4) Junction boxes and signal(s) contained within each junction box.
 - 5) Equipment power sources and associated circuit numbers.
 - 6) As-built drawings detailing wiring.
 - 2. Roof penetrations:
 - a. Show roof penetrations for electrical equipment and conduit on the roof drawing Submittal and include equipment information:
 - 1) Type.
 - 2) Size.
 - 3) Location.
 - 4) Configuration of individual penetrations or large penetrations for multiple conduits.
 - 5) Weight.
 - 6) Anchoring and support details.
- B. Sequencing and scheduling:
 - 1. Equipment anchoring: Project construction schedule must include an event for obtaining the anchor layout drawings from equipment manufacturers in adequate time for templates to be constructed and anchors to be cast-in-place.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Provide field wiring and terminations.
- B. Equipment mounting and anchoring:
 - 1. Design equipment anchorage, supports, and connections for dead load, running loads, loads during start-up, seismic load specified in Section 01_81_50 - Design Criteria, and other loads as required for proper operation of equipment.
 - a. For equipment with an operating weight of 400 pounds or greater and equipment that is supported higher than 4 feet above the floor, provide calculations for:
 - 1) Operating weight and location of the centroid of mass for the equipment.
 - 2) Forces and overturning moments.
 - 3) Shear and tension forces in equipment anchorages, supports, and connections.
 - 4) Design of equipment anchorage, supports, and connections based on calculated shear and tension forces.
 - 2. Anchorage of equipment to concrete or masonry:
 - a. Perform calculations and determine number, size, type, strength, and location of anchor bolts or other connections.
 - b. Unless otherwise indicated on the Drawings, select and provide anchors from the types specified in Section 05_05_24 - Mechanical Anchoring and Fastening to Concrete and Masonry.
 - c. Provide bolt sleeves around cast-in anchor bolts for 400 pounds or greater equipment.
 - 1) Adjust bolts to final location and secure the sleeve.
 - 3. Anchorage of equipment to metal supports:
 - a. Perform calculations and determine number, size, type, strength, and location of bolts used to connect equipment to metal supports.

2.03 MANUFACTURERS (NOT USED)

2.04 MATERIALS

- A. Enclosures:
 - 1. Provide enclosures for electrical, instrumentation, and control equipment, regardless of Supplier or Subcontractor furnishing the equipment, that meet the requirements of NEMA Standard 250.
 - a. Provide metallic enclosures unless specifically indicated otherwise.
- B. Stainless steel:
 - 1. Where stainless steel is indicated or used for any portion of the electrical Work, provide a non-magnetic, corrosion-resistant alloy, ANSI Type 316, satin finish.
 - 2. Provide exposed screws of the same alloys.

3. Use stainless steel hardware, when chemically compatible, in all chemical areas or areas requiring NEMA Type 4X construction.
 4. Do not use stainless steel in any area containing chlorine, gas or solution, chlorine products or ferric chloride.
- C. Plant area electrical work requirements:
1. Provide electrical materials in accordance with the following table, unless otherwise specifically indicated on the Drawings:

Table 1. Electrical Material Requirements				
Plant Area	Environment: W = Wet D = Damp C = Clean/dry X = Corrosive H = Hazardous	NEMA Enclosure Type	Exposed Conduit Type (as specified in Section 26_05_33 - Conduits)	Support Materials
Process Area and outside	W	3R	GRS	Hot Dipped Galvanized
Electrical Room	C	12	GRS	Hot Dipped Galvanized
Chlorine Room	X	4X Nonmetallic	Sch 80 PVC	Nonmetallic
Notes: (1) Outdoor classified areas require dual rating of NEMA 4X and 7.				

PART 3 EXECUTION

3.01 EXAMINATION

- A. Portions of this Project involve installation in existing facilities and interfaces to existing circuits, power systems, controls, and equipment:
1. Perform and document comprehensive and detailed field investigations of existing conditions (circuits, power systems, controls, equipment, etc.) before starting any Work.
 2. Determine information necessary to document, interface with, modify, upgrade, or replace existing circuits, power systems, controls, and equipment.
 3. Provide and document interface with, modifications to, upgrades, or replacement of existing circuits, power systems, controls, and equipment.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. Demolition:
1. As specified in Technical Sections or as indicated on the Drawings.
 2. Disconnect utilities:
 - a. Electrical equipment.
 - b. Other utilities as specified in Section 26_05_03 - Utility Coordination.

3. Remove and dispose of conduit, wire, electrical equipment, controls, etc., associated with the items and/or areas to be demolished as indicated on the Drawings unless otherwise indicated:
 - a. For each piece of equipment to be removed, remove ancillary components (e.g., instruments, solenoid valves, disconnect switches, etc.).
 - b. Remove wire back to the source for conduits to be removed or abandoned in place.
 - c. Unless otherwise indicated on the Drawings:
 - 1) Remove exposed conduit to the point of encasement or burial.
 - 2) Cut conduit flush and plug or cap encased or buried conduit.
 - d. Where conduits are to remain in place and removal is not indicated on the Drawings:
 - 1) Cap conduit open ends.
 - 2) Re-label empty conduits as spare.
 4. Demolish duct banks and direct buried conduits as indicated on the Drawings.
 5. Provide new nameplates for modified electrical distribution equipment, motor control centers etc., to identify equipment and circuits that are no longer used as spares.
 6. Provide new typewritten schedules for modified panelboards.
- B. Equipment:
1. Where the Drawings do not show dimensions for locating equipment, install equipment in the approximate locations indicated on the Drawings.
- C. Provide NEC required working space in front of electrical equipment as if it could be worked on energized.
- D. Circuits of different service voltage:
1. Voltage and service levels:
 - a. Medium voltage: Greater than 1.0 kV.
 - b. Low voltage:
 - 1) Power and controls: 120 V to 480 V.
 - c. Instrumentation: Less than 50 VDC.
 2. Install different service voltage circuits in separate raceways, boxes, manholes, and hand holes.
 3. Low voltage and instrumentation circuits may be installed in a common metallic box, wireway, or cable tray with a grounded divider as indicated on the Drawings.
- E. Conductors shall not pass through equipment they are not terminating in unless indicated on the Drawings or approved by the Engineer.

3.04 FIELD QUALITY CONTROL

- A. Workmanship:
1. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:
 - a. Neatly coil and label spare wiring lengths.
 - b. Shorten, re-terminate, and re-label excessively long used, as well as spare, wire and cable lengths, as directed by the Engineer.

- B. Inspection activities conducted during construction do not satisfy the inspection or testing requirements specified in Section 26_08_50 - Field Electrical Acceptance Tests.
- C. Provide on-site assistance for troubleshooting and correcting electrical issues discovered during installation and testing for the Project.

3.05 OWNER TRAINING (NOT USED)

3.06 ADJUSTING (NOT USED)

3.07 CLEANING

- A. General:
 - 1. Clean and vacuum enclosures to remove metal filings, surplus insulation and any visible dirt, dust, or other matter before energization of the equipment or system start-up:
 - a. Use of compressors or air blowers for cleaning is not acceptable.
 - 2. Clean luminaries in the areas affected by the construction.

END OF SECTION

SECTION 26_05_03
UTILITY COORDINATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Coordination with the utility companies to provide service.
 - 2. Contractor's responsibilities for connecting to utilities and providing utility service to the facilities.
 - 3. Descriptions of utility services required.
- B. Utility contacts:
 - 1. Electric utility:
 - a. Name: Rocky Mountain Power.
 - b. Utility: Electrical.
 - c. Phone number: 1-888-221-7070.

1.02 REFERENCES

- A. Underwriters Laboratories, Inc. (UL).

1.03 DELEGATED DESIGN (NOT USED)

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Certification:
 - 1. Submit certification that the intended installation has been coordinated with the utility companies.
 - 2. Include a narrative description of the utility's requirements and points of connection, names and telephone numbers for contacts at the utilities.

1.05 QUALITY ASSURANCE

- A. Materials and equipment used in performance of Electrical Work shall be listed or labeled by UL, or other equivalent recognized independent testing laboratory, for the class of service intended.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling:
 - 1. General:
 - a. Before the start of Site Work, make arrangements for temporary telephone and electrical service as required.
 - 2. Electrical systems:
 - a. Before bidding, contact the utilities to determine the Work and materials that will be required from the Contractor for inclusion in the bid.
 - b. Coordinate Work with the Engineer to minimize downtime of existing operating equipment and electrical distribution systems and to preclude unsafe operation:
 - 1) Notify Owner 10 days before power interruptions.
 - 2) Coordinate downtime with Owner and local electric utility.
 - c. Before commencing Work, coordinate electric service entrance requirements with local electric utility to ensure that the installation will be complete:
 - 1) Confirm the utility transformer size, electrical characteristics, and location are consistent with the design and service voltage provided by the electric utility.
 - 2) Arrange for utility revenue meter.
 - 3) Coordinate installation of metering CTs and PTs furnished by the electric utility.
 - d. During the construction of the Project, the existing electrical service must remain fully functional to supply uninterrupted electrical power to the facility.
 - 3. Before commencing Site Work, coordinate underground conduit installations with other Work to eliminate conflicts and avoid interferences with other underground systems.

1.09 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Electrical service:
 - 1. Temporary construction power:
 - a. Provide all Work and materials not provided by the electric utility.
 - b. Pay fees and costs for temporary construction power.
 - 2. Provide all Work and materials for providing the permanent electrical service, including, but not limited to:
 - a. Work and materials not provided by the electric utility.

- b. Provide electrical ducts, raceways, conductors, and connections indicated on the Drawings, and all other Work and materials required for a complete electrical service, including, but not limited to:
 - 1) Electrical service conduits and conductors from the point of electric utility connection to the service entrance equipment.
 - 2) Utility vaults and manholes located on the Project site.
 - c. Metering conduits from the instrument transformers to the meter.
 - B. General:
 - 1. Coordinate and obtain inspections and final installation approval from the serving utilities and authorities having jurisdiction.

2.03 MANUFACTURERS (NOT USED)

2.04 MATERIALS

- A. Provide materials in accordance with the applicable requirements of the utilities and as specified in these Specifications.

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

- A. Provide equipment in accordance with the applicable requirements of the utilities and as specified in these Specifications.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 26_05_53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Identification of electrical equipment, devices and components.
 - 2. Material, manufacturing and installation requirements for identification devices.

1.02 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).
- B. National Fire Protection Association (NFPA):
 - 1. 70 - National Electrical Code (NEC).
- C. Occupational Safety and Health Administration (OSHA).

1.03 DELEGATED DESIGN (NOT USED)

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Nameplates:
 - a. Color.
 - b. Size:
 - 1) Outside dimensions.
 - 2) Lettering.
 - c. Material.
 - d. Mounting means.
 - 2. Nameplate schedule:
 - a. Show exact wording for each nameplate.
 - b. Include nameplate and letter sizes.
 - 3. Wire numbers:
 - a. Manufacturer's catalog data for wire labels and label printer.
- C. Record documents:
 - 1. Update the conduit schedule to reflect the exact quantity of wire numbers, including spares and destination points for all wires.

1.05 QUALITY ASSURANCE (NOT USED)

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.09 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. Nameplates:
 - 1. Provide for control panel operator devices (e.g., pushbuttons, selector switches, pilot lights, etc.):
 - a. Same material and same color and appearance as the device nameplates to achieve an aesthetically consistent and coordinated system.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Nameplates:
 - 1. Provide for each piece of electrical equipment, device, control panel, and control panel components.
 - 2. Identical style, color, and material throughout the facility.
 - 3. Device nameplates information:
 - a. Equipment tag number as indicated on the Drawings.
- B. Wire numbers:
 - 1. Coordinate the wire numbering system with vendors of equipment so that every field wire has a unique number associated with it for the entire system:
 - a. Correspond to the wire numbers on the control drawings or the panel and circuit numbers for receptacles and lighting.
 - b. Correspond to the terminal block number to which they are attached in the control panel.
 - c. Internal panel wires on a common terminal shall have the same wire number.
 - d. Multi-conductor cables shall be assigned a cable number that shall be attached to the cable at intermediate pull boxes and stub-up locations beneath freestanding equipment. Multi-conductor and instrumentation cables shall be identified at pull points as described above:
 - 1) Label armored multi-conductor cable using the conduit number as indicated on the Drawings, following the requirements for conduit markers specified in Section 26_05_33 - Conduits.
 - 2. Provide the following wiring numbering schemes throughout the Project for field wires between process control module (PCM), vendor control panels (VCP), motor control centers (MCC), field starters, field instruments, etc.

(ORIGIN LOC.)–(ORIGIN TERM.)/(DEST. LOC.)–(DEST. TERM.)

(ORIGIN LOC.)–(ORIGIN TERM.)
(DEST. LOC.)–(DEST. TERM.)

OR:

Where:

ORIGIN LOC. = Designation for originating panel or device

ORIGIN TERM. = Terminal designation at originating panel or device

DEST. LOC. = Designation for destination panel or device

DEST. TERM. = Terminal designation at destination panel or device or PLC

3. I/O address at destination panel:
 - a. Identify equipment and field instruments as the origin.
 - b. PCMs are always identified as the destination.
 - c. Location is the panel designation for VCP, LCP, or PCM. For connections to MCCs, location is the specific starter tag and loop number. Location is the tag and loop number for motor starters, field instruments and equipment. Any hyphen in the panel designation or tag and loop number shall be omitted.
 - d. Terminal designation is the actual number on the terminal block where the conductor terminates at field devices and vendor control panels. For multi-conductor cables, all terminal numbers shall be shown, separated by commas.
 - e. Terminal designations at motor leads shall be the motor manufacturer's standard terminal designation (e.g., T1, T2, T3, etc.).
 - f. Terminal designations at PCMs where the field conductor connects to field terminal blocks for a PLC input or output shall be the PLC address
(Note: The following PLC I/O numbering scheme is typical for Allen-Bradley. The numbering scheme should be modified to match that of the actual PLC manufacturer used for the Project):

Discrete Point: W:X:Y/Z.

Analog Point: W:X:Y.Z.

Where:

W = I for input, O for output.

X = PLC number (1, 2, 3...)

Y = Slot number (01, 02, 03...)

Z = Terminal number (00, 01, 02...) for a discrete point or a word number for an analog point (1, 2, 3...)

- g. Terminal designations at PCMs where the conductor does not connect to a PLC I/O point shall be the terminal number with a "C" prefix (e.g., C0010). For common power after a fuse or neutrals after a switch, the subsequent points shall have and capital letter suffix starting with "A" (e.g., C0010A).

4. **Case 1:** Vendor control panel (VCP) to process control module (PCM):

Field wire number/label: A-B/C-D:

A = Vendor control panel number without hyphen (VCP#)

B = Terminal number within VCP (manufacturer's or vendor's standard terminal number)

C = Process control module number without hyphen (PCM#)

D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)

Examples:

VCP#-10/PCM#-I: 1:01/01

VCP#-10/PCM#-O: 1:10/07

VCP#-10/PCM#-C0100

5. **Case 2:** Field instrument to process control module (PCM):

Field wire number/label: E-F/C-D:

C = Process control module number without hyphen (PCM#)

D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)

E = Field mounted instrument tag and loop numbers without hyphen (EDV#)

F = Manufacturer's standard terminal number within instrument. Use both terminal numbers for analog points separated by a comma

Examples:

TIT#-2,3/PCM#-I: 1:01.1

TSH#-1/PCM#-I: 2:01/00

6. **Case 3:** Motor control center (MCC) to process control module (PCM):

Field wire number/label: G-B/C-D:

B = Terminal number within Motor Control Center (manufacturer's or vendor's standard terminal number)

C = Process control module without hyphen (PCM#)

D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)

G = Actual starter designation in the motor control center without hyphen (MMS#)

Examples:

MMS#-10/PCM#-I: 1:01/01

MMS#-10/PCM#-O: 1:10/07

MMS#-10/PCM#-C0100

7. **Case 4:** Motor control center (MCC) to vendor control panel (VCP):

Field wire number/label: G-B/A-B:

A = Vendor control panel number without hyphen (VCP#)

B = Terminal number within motor control center or vendor control panel (manufacturer's or vendors standard terminal number)

G = Actual starter designation in the motor control center without hyphen (MMS#)

Example:

MMS#-X2/VCP#-10

8. **Case 5:** Motor leads to a motor control center (MCC):

Field wire number/label: H-I/G-B:

B = Terminal number within motor control center (manufacturer's standard terminal number)

G = Actual starter designation in the motor control center without hyphen (MMS#)

H = Equipment tag and loop number without hyphen (PMP#)

I = Motor manufacturer's standard motor lead identification (e.g., T1, T2, T3, etc.)

Example:

PMP#-T3/MMS#-T3

9. **Case 6:** Remote or separately mounted starter or variable frequency drive (VFD) to process control module (PCM):

Field wire number/label: J-B/C-D:

B = Terminal number within starter or variable frequency drive (manufacturer's standard terminal number)

C = Process control module number without hyphen (VCP#)

D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)

J = Starter or variable frequency drive tag and loop number without hyphen (MMS#)

Examples:

MMS#-10/PCM#-I: 1:01/01

MMS#-10/PCM#-O: 2: 10/07

MMS#-10/PCM#-C0010

10. **Case 7:** Field bus trunk segment:

Field cable number/label: C/K-L/M; C/K-L/H; C/K-L/J:

C = Process control module without hyphen (PCM#)

K = Field bus cable type

L = Field bus segment number

M = Field Bus field network component without hyphen (PTB1) or

H = Equipment tag and loop number without hyphen (EMV#) or

J = Starter or variable frequency drive tag and loop number without hyphen (VFD60.0112)

Examples:

PCM#/PA-1A/PTB1PTB1/PA-1B/PTB2

PCM#/DN-1A/VFD#

PCM#/DP-2A/ EMV#

11. **Case 8:** Field bus spur (drop):

Field cable number/label: E/K-L/M:

E = Field mounted instrument tag and loop numbers without hyphen (FIT#)

K = Field bus cable type.

L = Field bus segment number

M = Field bus field network component without hyphen (PTB1), identify ports on the device.

Examples:

FIT#/PA-1C/PTB1-1

FIT#/PA-1D/PTB1-2

12. Identify spare conductors as required for other field wires with an "S" prefix:

Example:

S MMS#-10/PCM#-C011.

2.03 MANUFACTURERS

A. Nameplates and signs:

1. One of the following or equal:

- a. Brady.
- b. Seton.

B. Conductor and cable markers:

1. Heat-shrinkable tubing:

- a. One of the following or equal:
 - 1) Brady.
 - 2) Kroy.

- 3) Panduit.
 - 4) Raychem.
 - 2. Non heat-shrinkable tubing:
 - a. One of the following or equal:
 - 1) Brady.
 - 2) Panduit.
 - 3) Seton.
 - 3. Pre-printed slip-on sleeve markers:
 - a. The following or equal: Engineer knows of no equal.
 - 1) Grafoplast.
- C. Conduit and raceway markers:
 - 1. Non-metallic: One of the following or equal:
 - a. Almetek: Mini Tags.
 - b. Lapp Group: Maxi System.
 - 2. Stainless steel: One of the following or equal:
 - a. Panduit.
 - 3. Brass: One of the following or equal:
 - a. Panduit.

2.04 MATERIALS

- A. Nameplates:
 - 1. Colors:
 - a. Warning: White-center, red face.
 - b. Other: Black-center, white face.
 - 2. Laminated plastic engraving stock:
 - a. 1/16-inch-thick material.
 - b. 2-ply.
 - 3. With chamfered edges.
 - 4. Lettering:
 - a. Block style engraved characters of adequate size to be read easily from a distance of 6 feet.
 - b. Minimum letter height: 1/8 inch.
- B. Signs:
 - 1. Automatic equipment and high voltage signs:
 - a. Suitable for exterior use.
 - b. In accordance with OSHA regulations.
- C. Conductor and cable markers:
 - 1. Lettering:
 - a. Machine printed black characters on white tubing.
 - b. Minimum letter height: 10-point type or larger.
- D. Conduit and raceway markers:
 - 1. Non-metallic:
 - a. UV resistant holder and letters.
 - b. Black letters on yellow background.
 - c. Minimum letter height: 1/4 inch.
 - d. Adhesive labels are not acceptable.

2. Stainless steel:
 - a. Type 304 or Type 316.
 - b. Minimum letter height: 3/16 inch.
3. Solid brass:
 - a. Minimum thickness: 0.036 inches.
 - b. Letter characters stamped.
 - c. Minimum letter height: 3/16 inch.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. Nameplates:
 1. Attach to equipment with rivets, bolts, or sheet metal screws, approved waterproof epoxy-based cement or install in metal holders welded to the equipment.
 2. Provide for each disconnecting means with the following:
 - a. Equipment served, voltage, and fuse size as required.
 - b. Identification of the circuit source that supplies the disconnecting means.
 3. On NEMA Type 4, NEMA Type 4X, or NEMA Type 7 enclosures, use epoxy-based cement to attach nameplates.
 4. Aligned and level or plumb to within 1/64 inch over the entire length:
 - a. Misaligned or crooked nameplates shall be remounted or provide new enclosures at the discretion of the Engineer.
- B. Conductor and cable markers:
 1. Apply before termination.
 2. Heat-shrinkable tubing:
 - a. Shrunk using a heat gun that produces low temperature heated air.
 - b. Tight on the wire after it has been heated.
 - c. Characters shall face the open panel and shall read from left to right or top to bottom.
 - d. Marker shall start within 1/32 inch of the end of the stripped insulation point.
 3. Non heat-shrinkable tubing:
 - a. Sized for the wire and insulation on which it is to be placed.
 - b. Tight on the wire.
 - c. Characters shall face the open panel and shall read from left to right or top to bottom.
 - d. Marker shall start within 1/32 inch of the end of the stripped insulation point.
- C. Conduit markers:
 1. Furnish and install markers for every conduit in the electrical system that is identified in the conduit schedule or part of the process system:
 - a. Markings shall match the conduit schedule.

2. Mark conduits at the following locations:
 - a. Each end of conduits that are greater than 10 feet in length.
 - b. The middle of conduits that are 10 feet or less in length.
 - c. Where the conduit penetrates a wall, structure, manhole, or handhole.
 - 1) Marker shall be non-metallic with stainless steel hardware.
 - d. Where the conduit emerges from the ground, slab, etc.
 3. Mark conduits after the conduits have been fully painted.
 4. Position conduit markers so that they are easily read from the floor.
 5. Attach non-metallic conduit markers with nylon cable ties:
 - a. Provide ultraviolet resistant cable ties for conduit markers exposed to direct sunlight.
 6. Attach stainless steel tags with stainless steel cable ties.
 7. Attach brass tags with Type 316 stainless steel wires.
 8. Mark conduits before construction review by the Engineer for punch list purposes.
 9. Label intrinsically safe conduits in accordance with the requirements of the NEC.
 10. Stainless steel tags and cable ties shall not be used in areas with high chlorine concentrations.
- D. Signs and labeling:
1. Furnish and install permanent warning signs at mechanical equipment that may be started automatically or from remote locations:
 - a. Fasten warning signs with round head stainless steel screws or bolts.
 - b. Locate and mount in a manner to be clearly legible to operations personnel.
 2. Furnish and install permanent and conspicuous warning signs on equipment (front and back), doorways to equipment rooms, pull boxes, manholes, etc., where the voltage exceeds 600 volts.
 3. Furnish and install warning signs on equipment that has more than one source of power.
 - a. Warning signs to identify every panel and circuit number of the disconnecting means of external power sources.
 4. Place warning signs on equipment that has 120 VAC control voltage source used for interlocking.
 - a. Identify panel and circuit number or conductor tag for control voltage source disconnecting means.
 5. Label service entrance equipment, switchgear, switchboards, MCCs, panelboards, and transfer switches with the available short circuit current, equipment label, and date of application in accordance with NEC. Coordinate with Section 26_05_74 - Electrical System Studies for available fault current data.

3.04 FIELD QUALITY CONTROL

- A. Replace any nameplates, signs, conductor markers, cable markers, or raceway labels that in the sole opinion of the Engineer do not meet the Engineer's aesthetic requirements.

END OF SECTION

SECTION 26_05_74

ELECTRICAL SYSTEM STUDIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Short-circuit fault analysis studies.
 - 2. Protective device coordination study.
 - 3. Machine and electrical system settings.
 - 4. Arc-flash hazard study.

1.02 REFERENCES

- A. American National Standards Institute (ANSI).
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations.
- C. National Fire Protection Association (NFPA):
 - 1. 70E - Standard for Electrical Safety in the Workplace.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. Final electrical system study report: The Delegated Design final report that incorporates installed cable lengths, and all construction changes.
 - 2. Initial short-circuit fault analysis: An analysis done based on the Drawings and utility information. The purpose is to identify the available fault current at each piece of equipment to make sure it is properly rated.
 - 3. Modified: Equipment with load additions or with loads being removed that affect fault current, include new overcurrent protective devices that require settings and device coordination.
 - 4. Preliminary electrical system studies:
 - a. If startup and sequencing occur before the final study is completed, perform a preliminary study as needed to determine temporary protective device settings.
 - b. Preliminary studies will not be reviewed by the Engineer but shall be submitted for record.

1.04 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Signed and sealed electrical system study reports.

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Credentials of the individual(s) performing the study and the individual in responsible charge of the study.
- C. General:
 - 1. Format and quantity:
 - a. 2 bound copies of all final reports.
 - b. Complete set of electronic files, including the electrical system model(s), configuration files, custom libraries, and any other files used to perform the studies and produce the reports. Also provide an electronic version of the bound reports in PDF format.
 - 2. One-line diagrams:
 - a. The following information shall be included at a minimum:
 - 1) Motor horsepower.
 - 2) Transformer data:
 - a) kVA.
 - b) Configuration.
 - 3) Cable data:
 - a) Insulation.
 - b) Size.
 - c) Length.
 - b. Fully legible at 11-inch by 17-inch size.
- D. Initial short-circuit fault analysis:
 - 1. Based on the Contract Documents and electric utility information.
 - 2. Include a description of all operating scenarios.
 - 3. One-line diagrams.
 - 4. Indicate the estimated available short-circuit current at the line side terminals of each piece of equipment covered by the scope of the study.
 - a. Measure conductor lengths from the Drawings. Use of arbitrary short conductor lengths is not allowed.
 - b. Provide a list of assumptions used in the initial study.
- E. Delegated Design final studies and reports:
 - 1. Include the following sections at a minimum:
 - a. Copies of correspondence and data obtained from the electric utility company.
 - b. Letter certifying the inspection and verification of existing equipment and incorporation of applicable RFIs and change orders.
 - c. Short-circuit fault analysis:
 - 1) Modify the initial short-circuit fault analysis as follows:
 - a) Utilize the actual equipment provided on the Project.
 - b) Utilize conductor lengths based on installation.
 - c) Update one-line diagrams to show as-built conditions.
 - 2) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
 - 3) Normal system connections and those that result in maximum fault conditions.

- 4) Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short-circuit duties.
- 5) Fault current calculations for the cases run, including a definition of terms and guide for interpretation of computer software printouts.
- d. Protective device coordination study shall include:
 - 1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
 - 2) List requirements used in the selection and setting criteria for any protective devices.
 - 3) Manufacturer's time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for new equipment.
 - 4) TCCs graphically indicating the coordination proposed for the system on log-log graphs:
 - a) All TCCs shall be in color.
 - 5) Tabulation of relay, fuse, circuit breaker, and other protective devices in graphical form with a one-line diagram to display area coordination.
 - 6) Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination. Recommended equipment modifications or settings shall be in a tabulated form.
 - 7) Protective device settings in a tabulated format.
- e. Include in the arc-flash hazard study:
 - 1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
 - 2) Normal system connections and those that result in maximum arc-flash conditions.
 - 3) Arc-flash raw data, calculations, and assumptions.
- f. Form and format of arc-flash labels.
 - 1) Label data:
 - a) Identifying the content of each label.
 - b) Identifying the location of each label.

F. Signature page identifying the name for the person entering the setting and a representative of the Contractor for each protective device requiring setting or adjustment.

G. Submit course outline for Owner Training.

1.06 QUALITY ASSURANCE

- A. Qualifications of the entity responsible for electrical system studies:
1. Short-circuit fault analysis, protective device coordination, and arc-flash hazard studies shall be performed with the aid of a digital computer program:
 - a. Point-to-point calculations are not acceptable.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Individual performing the studies shall visit the Site and collect necessary field data in order to perform and complete comprehensive electrical system studies.
2. Obtain, for all equipment, the required data for preparation of the study, including, but not limited to:
 - a. Transformer kilovolt-ampere (kVA), nameplate data, and impedances.
 - b. Generator impedances, kilovolt-ampere (kVA), and voltage.
 - c. Generator decrement curves.
 - d. Bus withstand ratings.
 - e. Cable and bus data.
 - f. Protective device taps, time dials, instantaneous pickups, and time-delay settings.
 - g. As-built lengths for new wire and cable installations covered by the studies.
 - h. Grounding schemes (solidly grounded or resistive grounded).
3. Obtain the electric utility information on the minimum and maximum available fault current, minimum and maximum utility impedances, utility protective device settings, including manufacturer and model number, interrupting ratings, X/R ratios, and model information one level above the point of connection:
 - a. Utility tolerances and voltage variations.
 - b. Coordinate with the utility for changes to their protective devices and settings to achieve a coordinated system between the utility and the Owner.
4. Obtain equipment layouts and configurations from the manufacturer's final Submittal requirements and project layout drawings as required.
5. Bus and conductor data:
 - a. Use impedances of the actual installed or specified conductors, unless otherwise indicated.
 - b. Use cable and bus impedances calculated at 25 degrees Celsius, unless otherwise indicated.
 - c. Use 600-volt cable reactance based on typical dimensions of actual installed or specified conductors, unless otherwise indicated.
 - d. Use bus withstand values for all equipment having buses.

B. Use medium-voltage cable reactance based on typical dimensions of shielded cables with 133 percent insulation levels, unless otherwise indicated.

C. Certification:

1. Submit written certification signed by the professional engineer conducting the study, equipment supplier, and electrical subcontractor, stating that the data used in the study is correct and captures all RFIs, as-builts, and change orders affecting the study.

D. Meetings:

1. Electrical system study meetings:
 - a. As specified in Section 01_31_19 - Project Meetings.
 - b. The individual conducting the electrical system studies leads the meeting.
 - c. Meet with the Owner and Engineer 3 times.
 - d. First meeting:
 - 1) Discuss the scope of the studies.

- 2) Confirm electrical system operating modes.
 - 3) Confirm assumptions to be used in the electrical system study with the Owner, including, but not limited to:
 - a) Maximum protective device fault clearing time.
 - 4) Discuss the Owner's operational requirements for both normal operation and maintenance.
 - e. Second meeting:
 - 1) Inform the Owner of the results of the study and impacts on normal operation and maintenance, including:
 - a) Protective device coordination problems and recommended solutions.
 - b) Explanation of the arc-flash hazard study results and its potential impact on operations.
 - c) Recommendations for reduction of arc-flash category levels, including reduction of protective device settings or changes in operational practices.
 - f. Final meeting:
 - 1) Prior to Substantial Completion.
 - 2) Discuss changes to the studies based on the previous meeting.
 - 3) Discuss with the Owner how changes to the electrical system may change the arc-flash hazard category.
- E. Sequencing:
- 1. Below is an outline of the typical work sequence. Proposed changes to the work sequence may be reviewed and approved by the Engineer.
 - a. First system study meeting.
 - b. Submit the initial short-circuit fault analysis study before submittal of any electrical equipment.
 - 1) Only the initial short-circuit results will be reviewed.
 - c. Site visit to gather data on the existing facility systems for all studies:
 - 1) Make multiple trips as required to obtain data for the short-circuit fault analysis, protection device coordination, and arc flash hazard studies.
 - d. Conduct preliminary protective device coordination analysis and overcurrent device settings as required to accommodate project and sequencing.
 - e. Submit the draft short-circuit fault analysis, protective device coordination, and arc-flash hazard studies after the approval of all electrical equipment.
 - f. Second system study meeting for preliminary results.
 - g. Update the model with changes to the electrical system made during start-up and commissioning.
 - h. Final system study meeting.
 - i. Submit the final electrical system studies.
 - j. Label equipment with approved arc-flash labels.
 - k. Owner Training.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

A. General study requirements:

1. Scope:
 - a. Short-circuit fault analysis, protective device coordination, and arc-flash hazard studies shall include all equipment in the power distribution system, including, but not limited to:
 - 1) Utility equipment (utility transformer and primary protective device).
 - 2) Available utility fault contribution current.
 - 3) All electrical equipment, including:
 - a) Dry-type transformers.
 - b) 240- and 208-volt panelboards.
 - 4) Generators.
 - 5) Motors.
 - 6) Vendor control panels.
 - 7) HVAC equipment.
 - b. Study scenarios:
 - 1) Include all possible electrical system configurations, for example:
 - a) Operation on normal (utility) source.
 - b) Operation on generator source.
 - c) Main-breakers closed; tie-breaker open.
 - d) Either main-breaker open; tie-breaker closed.
2. Motors:
 - a. Each motor shall be individually modeled:
 - 1) Grouping of motors for fault contribution current is not acceptable.
 - b. Motors with variable frequency drives (VFDs) may be assumed to have no contribution to fault current, unless VFDs are equipped with bypass contactors.
 - 1) If VFDs are equipped with bypass contactors, perform the fault current and arc flash study assuming all of bypass contactors are in the closed position.
3. Use the equipment, bus, and device designations as indicated on the Drawings for all studies.

B. Short-circuit fault analysis study additional requirements:

1. Calculate 3-phase bolted fault, line-to-line fault, line-to-ground fault, double line-to-ground fault, short-circuit 1/2 cycle momentary symmetrical and asymmetrical RMS, 1-1/2 to 4 cycle interrupting symmetrical RMS, and 30-cycle steady-state short-circuit current values at each piece of equipment in the distribution system.
2. Evaluate bus bracing, short-circuit ratings, fuse interrupting capacity and circuit-breaker-adjusted interrupting capacities against the fault currents, and calculate X/R values:
 - a. Identify and document all devices and equipment as either inadequate or acceptable.
3. Calculate line-to-ground and double line-to-ground momentary short-circuit values at buses having ground-fault devices.

4. Provide calculation methods, assumptions, one-line diagrams, and source impedance data, including utility X/R ratios, typical values, recommendations, and areas of concern.
- C. Protective device coordination study additional requirements:
1. Furnish protective device settings for functions indicated on the Drawings, including, but not limited to:
 - a. Current.
 - b. Voltage:
 - 1) Provide settings for voltage relays based upon actual utility and generator tolerances and specifications.
 - c. Frequency:
 - 1) Provide settings for frequency relays based upon actual utility and generator tolerances and specifications.
 - d. Negative sequence.
 - e. Reverse power.
 - f. Bus differential.
 - g. Machine protection functions:
 - 1) Provide settings for motor and generator protective relays based on the manufacturer's recommended protection requirements.
 2. Provide log-log form time-current curves (TCCs) graphically indicating the coordination proposed for the system:
 - a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular TCC:
 - 1) Typical TCCs for identical portions of the system, such as motor circuits, are acceptable as allowed by the Engineer.
 - b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics:
 - 1) These details can be included on the TCC.
 - c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings:
 - 1) These details can be included on the TCC.
 3. TCCs shall include all equipment in the power distribution system where required to demonstrate coordination. Include utility relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics, and characteristics of other system load protective devices:
 - a. Include devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, main breaker in branch panelboards, and fused disconnect switches.
 - b. Provide ground fault TCCs with adjustable settings for ground fault protective devices.
 - c. Include manufacturing tolerances and damage bands in plotted fuse and circuit breaker characteristics.
 - d. On the TCCs, show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and transformer damage curves.
 - e. Cable damage curves.

- f. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed based on the short-circuit fault analysis study.
 - g. Coordinate time interval medium-voltage relay characteristics with upstream and downstream devices to avoid nuisance tripping.
 - 4. When site generation (including cogeneration, standby, and emergency generators) is part of the electrical system, include phase and ground coordination of the generator protective devices:
 - a. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices.
 - 5. Suggest modifications or additions to equipment rating or settings in a tabulated form.
- D. Arc-flash hazard study additional requirements:
 - 1. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:
 - a. Perform study with 15 percent arcing fault variation in accordance with IEEE 1584.
 - b. Perform arc-flash calculations at minimum and maximum utility and generator fault contributions.
 - c. Perform arc-flash calculations for both the line side and load side of the switchgear, switchboard, motor control center, and panelboard main breakers.
 - d. Perform arc-flash calculations for short-circuit scenarios with all motors on for 3 to 5 cycles and with all motors off.
 - 2. Provide executive summary of the study results:
 - a. Provide summary based upon worst case results.
 - 3. Provide a detailed written discussion and explanation of the tabulated outputs:
 - a. Include all scenarios.
 - 4. Provide alternative device settings to allow the Owner to select the desired functionality of the system:
 - a. Minimize the arc-flash energy by selective trip and time settings for equipment maintenance purposes.
 - b. Identify the arc-flash energy based upon the criteria of maintaining coordination and selectivity of the protective devices.

2.03 MANUFACTURERS

- A. Electrical system study software: One of the following or equal:
 - 1. Operation Technology, Inc., ETAP.
 - 2. SKM Systems Analysis, Powertools.

2.04 EXISTING PRODUCTS (NOT USED)

2.05 MATERIALS (NOT USED)

2.06 MANUFACTURED UNITS (NOT USED)

2.07 EQUIPMENT (NOT USED)

2.08 COMPONENTS

- A. Arc-flash hazard labels:
 - 1. Dimensions:
 - a. Minimum 5 inches by 3.5 inches.
 - 2. Materials:
 - a. Polyester with polyvinyl polymer over-laminate.
 - b. Self-adhesive.
 - c. Resistant to:
 - 1) UV.
 - 2) Chemicals and common cleaning solvents.
 - 3) Scuffing.
 - 4) Wide temperature changes.
 - 3. Contents:
 - a. Short-circuit bus identification.
 - b. Calculated incident energy (calories/square centimeter) range:
 - 1) Based on worst-case study results.
 - c. Site-specific personal protective equipment level number.
 - d. Arc-flash protection boundary.
 - e. Shock hazard boundary:
 - 1) Provide separate labels for indication of the shock hazard boundary.
 - f. Fed from:
 - 1) Identify the tag number of the upstream equipment providing power.
 - 4. Color scheme:
 - a. For locations above 40 calories/square centimeter:
 - 1) White label with red "DANGER" strip across the top.
 - 2) Black lettering.
 - b. For locations below 40 calories/square centimeter:
 - 1) White label with orange "WARNING" strip across the top.
 - 2) Black lettering.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. After review and acceptance of the arc-flash hazard study by the Engineer, install arc-flash hazard labels:
 - 1. At all locations required by NFPA, ANSI, or IEEE standards.
 - 2. At a minimum, in the following locations:
 - a. Front of each main or incoming service compartment.
 - b. Front of each low-voltage switchgear section.
 - c. Front of each medium-voltage circuit breaker door.
 - d. Front of each accessible auxiliary or conductor compartment.
 - e. Each accessible rear or side vertical section.
 - f. Each motor control center vertical section.
 - g. Each panelboard covered by the study.

- h. Each control panel, individual starter or VFD, or other equipment covered by the scope of the study.

3.04 OWNER TRAINING

- A. Including, but not limited to:
 - 1. Introduction and basics of NFPA 70E: 2 hours 2 sessions.
 - 2. Detailed review of the electrical system study: 2 hours 1 session.

3.05 FIELD QUALITY CONTROL

- A. Individual performing the arc-flash hazard study shall direct the installation of the arc-flash hazard labels:
 - 1. Remove existing labels from previous studies that are outdated.
 - 2. Remove and replace any improperly applied labels.
 - 3. Repair the equipment finish damaged by removal of any label.
 - 4. Install labels level or plumb across the entire dimension of the label.

3.06 ADJUSTING

- A. After review and acceptance of the draft arc-flash hazard study and protective device coordination study by the Engineer, adjust protective device settings in accordance with final study prior to equipment energization.
 - 1. Devices that require power for configuration may be set during energization, but before any subfed loads are energized.
 - 2. Ensure that settings for upstream equipment are set prior to energizing downstream devices. Provide documentation that protective devices are set in accordance with the study recommendation.

END OF SECTION

SECTION 26_08_50

FIELD ELECTRICAL ACCEPTANCE TESTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Responsibilities for testing the electrical installation.
 - 2. Adjusting and calibration.
 - 3. Acceptance tests.
- B. Copyright information:
 - 1. Some portions of this Section are copyrighted by the InterNational Electrical Testing Association, Inc. (NETA). See NETA publication ATS for details.

1.02 REFERENCES

- A. Project references:
 - 1. Specification sections for the electrical equipment being tested.
 - 2. Electrical equipment Shop Drawings.
- B. Standards:
 - 1. ASTM International (ASTM):
 - a. D971 - Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
 - b. D974 - Standard Test Method for Acid and Base Number by Color-Indicator Titration.
 - c. D1500 - Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
 - 2. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 43 - IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.
 - b. 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.
 - c. 95 - IEEE Recommended Practice for Insulation Testing of AC Electric Machinery (2,300 V and Above) With High Direct Voltage.
 - d. C57.13 - IEEE Standard Requirements for Instrument Transformers.
 - e. C57.13.1 - IEEE Guide for Field Testing of Relaying Current Transformers.
 - f. C57.13.3 - IEEE Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.
 - 3. Insulated Cable Engineer's Association (ICEA).
 - 4. InterNational Electrical Testing Association (NETA).
 - a. ATS- Standard for Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
 - 5. International Electrotechnical Commission (IEC).

6. National Electrical Manufacturers Association (NEMA):
 - a. ANSI/NEMA EN 10250 - Enclosures for Electrical Equipment (1000 V Maximum).
 - b. MG1 - Motors and Generators.
7. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC).
 - b. 110 - Standard for Emergency and Standby Power Systems.
8. National Institute of Standards and Technology (NIST).

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 1. Testing laboratory: Organization performing the acceptance tests.

1.04 DELEGATED DESIGN (NOT USED)

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Copper Ethernet test form:
 1. Cable test reports:
 - a. Submit 3 copies of test reports showing the results of all tests specified in this Section:
 - 1) Test type.
 - 2) Test location.
 - 3) Test date.
 - 4) Cable number.
 - 5) Cable length.
 - 6) Certification that the cable meets or exceeds the specified standard.
 - b. Furnish hard copy and electronic copy for all traces.
- C. Manufacturers' testing procedures:
 1. Submit manufacturers' recommended testing procedures and acceptable test results for review by the Engineer prior to beginning testing.
- D. Test report:
 1. Include the following:
 - a. Summary of Project.
 - b. Description of equipment tested.
 - c. Description of tests performed.
 - d. Test results.
 - e. Conclusions and recommendations.
 - f. Completed test forms.
 - g. List of test equipment used and calibration dates.
 - h. LAN cable test reports.
- E. Test data records:
 1. Include the following:
 - a. Identification of the testing organization.

- b. Equipment identification.
 - c. Nameplate data.
 - d. Humidity, temperature and/or other conditions that may affect the results of the tests and/or calibrations.
 - e. Dates of inspections, tests, maintenance and/or calibrations.
 - f. Indication of the inspections, tests, maintenance, and/or calibrations to be performed and recorded.
 - g. Expected results when calibrations are to be performed.
 - h. Indication of as-found and as-left results as applicable.
 - i. Indication of test results outside specified tolerances.
- F. Testing laboratory qualifications:
- 1. Submit a complete resume and statement of qualifications from the proposed testing laboratory detailing their experiences in performing the tests specified:
 - a. This statement will be used to determine whether the laboratory is acceptable and shall include:
 - 1) Corporate history and references.
 - 2) Resume of individual performing test.
 - 3) Equipment list and test calibration data.
- G. Division of responsibilities:
- 1. Submit a list identifying who is responsible for performing each portion of the testing.

1.06 QUALITY ASSURANCE

- A. Testing laboratory qualifications:
- 1. May be qualified testing personnel from the electrical subcontractor's staff or an independent testing company.
 - 2. NETA certification required.
 - 3. Selection of the testing laboratory and testing personnel is subject to approval by the Engineer based on testing experience and certifications of the individuals and testing capabilities of the organization.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.09 ADMINISTRATIVE REQUIREMENTS

- A. General requirements:
- 1. Testing of electrical equipment installed under this Contract in accordance with the manufacturer's requirements and as specified in this Section.
 - 2. Conduct tests in the presence of the Engineer or the Engineer's representative:
 - a. Engineer will witness visual, mechanical, and electrical tests, and inspections.
 - 3. Testing and inspections shall verify that the equipment is operational within the tolerances required and expected by the manufacturer, and these Specifications.

- B. Responsibilities:
1. Contractor responsibilities:
 - a. Ensure that resources are made available for testing and that testing requirements are met.
 2. Electrical subcontractor responsibilities:
 - a. Perform routine tests during installation.
 - b. Demonstrate operation of electrical equipment.
 - c. Commission the electrical installation.
 - d. Provide the necessary services during testing and provide these services to the testing laboratory, Contractor, and other subcontractors, including, but not limited to:
 - 1) Providing electrical power as required.
 - 2) Operating of electrical equipment in conjunction with testing of other equipment.
 - 3) Activating and shutting down electrical circuits.
 - 4) Making and recording electrical measurements.
 - 5) Replacing blown fuses.
 - 6) Installing temporary jumpers.
 3. Testing laboratory responsibilities:
 - a. Perform acceptance tests specified in this Section.
 - b. Provide required equipment, materials, labor, and technical support during acceptance tests.
- C. Sequencing:
1. Prior to testing:
 - a. At least 30 days before commencement of the acceptance tests, submit the manufacturer's complete field testing procedures to the Engineer and to the testing laboratory, complete with expected test results and tolerances for equipment to be tested.
 2. Perform testing in the following sequence:
 - a. Perform routine tests as the equipment is installed, including:
 - 1) Insulation-resistance tests.
 - 2) Continuity tests.
 - 3) Rotational tests.
 - b. Adjusting and preliminary calibration.
 - c. Acceptance tests.
 - d. Demonstration.
 - e. Commissioning and plant start-up.

1.10 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

- A. Test instrument calibration:
 - 1. Utilize a testing laboratory with a calibration program which maintains applicable test instrumentation within rated accuracy.
 - a. Calibrating standard shall be of better accuracy than that of the equipment tested.
 - 2. Accuracy shall be traceable to the NIST in an unbroken chain.
 - 3. Calibrate instruments in accordance with the following frequency schedule:
 - a. Field instruments: 6 months maximum.
 - b. Laboratory instruments: 12 months maximum.
 - c. Leased specialty equipment where the accuracy is guaranteed by the lessor (such as Doble): 12 months maximum.
 - 4. Dated calibration labels shall be visible on test equipment.
 - 5. Maintain an up-to-date instrument calibration record for each test instrument:
 - a. Records shall show the date and results of each calibration or test.
 - 6. Maintain an up-to-date instrument calibration instruction and procedure for each test instrument.
- B. Requirements prior to testing:
 - 1. Do not begin testing until the following conditions have been met:
 - a. Instruments required are available and in proper operating condition.
 - b. Required dispensable materials such as solvents, rags, and brushes are available.
 - c. Equipment handling devices such as cranes, vehicles, chain falls, and other lifting equipment are available or scheduled.
 - d. Instruction books, calibration curves, or other printed material to cover the electrical devices are available.
 - e. Datasheets to record test results are available.
- C. Engine generator tests:
 - 1. The following individuals must be present and remain at the Site during the entire field testing of the engine generator:
 - a. Manufacturer's field engineer for the voltage regulator.
 - b. Manufacturer's field engineer for the governor and governor controller.
 - c. Manufacturer's field engineer for the switchgear.
 - d. Load bank operator.
 - e. Electrical contractor.
 - f. Electric utility's field engineer for accepting the co-generation system.

3.03 INSTALLATION

- A. Test decal:
 - 1. Testing laboratory shall affix a test decal on the exterior of equipment or equipment enclosure of protective devices after performing electrical tests.

2. Color coded to communicate the condition of maintenance of the protective devices. Color scheme for condition of maintenance of overcurrent protective devices shall be:
 - a. White: Electrically and mechanically acceptable.
 - b. Yellow: Minor deficiency not affecting fault detection and operation, but minor electrical or mechanical condition exists.
3. Shall include the following information at a minimum:
 - a. Testing organization.
 - b. Project identifier.
 - c. Test date.
 - d. Technician identifier.

3.04 COMMISSIONING

- A. As specified in Section 01_75_17 - Commissioning.
- B. Functional Testing:
 1. Also called Field Acceptance Testing.
- C. Panelboards:
 1. Cleaning:
 - a. Visually inspect panelboard for evidence of discoloration, abnormal dust accumulation, metal shards, or any other indication of overheating, wear, or other abnormal conditions prior to cleaning.
 - b. Clean cabinet with a brush, vacuum cleaner, or clean, dry, lint-free rags to remove any accumulation of dust, dirt, or other foreign matter. Do not use liquids, solvents or detergents when cleaning panelboards or components.
 - c. Avoid blowing dust into panelboards. Do not use a blower or compressed air.
 - d. Clean supports, terminals, and other major insulating surfaces with clean, dry, lint-free rags or soft bristled brushes.
 - e. Remove dust, soot, grease, moisture, and foreign material from surface of circuit breakers.
 2. General:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Check panelboard circuit schedule for accuracy.
 - c. Verify appropriate anchorage, required area clearances, and correct alignment.
 - d. Inspect overall general condition for physical damage.
 - 1) Check for broken studs and loose or damaged wires, connector, terminations, etc.
 - 2) Check bolts, nuts, washer, and pins for tightness.
 - 3) Tighten or use manufacturer's replacement parts as required.
 - e. Inspect cabinets for signs of rust, corrosion, or deteriorating paint. Inspect cabinets for evidence of localized heat damage to the paint. Investigate sources of heat. Repair painted surfaces.
 - f. Check that covers are in place and fastened. Plug any open unused knockouts.
 - g. Inspect panelboard for moisture. Seal off any cracks or openings which have allowed moisture to enter the cabinet. Inspect component devices. Replace any components that show evidence of damage from moisture.

- h. Look for any recent changes in sprinklers or other plumbing that might expose indoor panelboards to a source of liquids. Eliminate sources of water, moisture, or liquids, or provide adequate barriers to protect panelboards from sources of water, moisture, or liquids.
 - i. Inspect panelboards and internal components for evidence of overheating, arc spatter, sooty deposits, and tracking.
 - 1) Investigate and correct sources of arcing or overheating.
 - 2) Consult the panelboard manufacturer for recommendations.
 - j. Verify that fuse and/or circuit breaker sizes and types correspond to record drawings, if available, as well as to the circuit breakers' address for microprocessor communications packages, if equipped.
 - k. Set adjustable circuit breakers in accordance with engineering coordination study supplied by the Contractor.
3. Terminations, connections, and lugs:
- a. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections:
 - (1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - b. Inspect terminations, connection, and lugs for alignment, physical damage, burns, corrosion, discoloration, flaking, heat damage, arcing, pitting, melting, deterioration, carbonization, cracks, chips, breaks, partial discharge, or moisture. Investigate and eliminate sources of any damage.
 - c. Follow manufacturer recommendations for cleaning, repairing, and replacing damaged parts.
 - d. Replace overheated connections. Tighten connections to proper torque levels as specified above.
4. Conductors and raceways:
- a. Inspect supply conductors and terminations for overheating, discoloration, and oxidation. Investigate and correct any deficiencies.
 - b. Ensure the conductors are protected within their ampacities.
 - c. Visually check panelboard, cables, and raceways for proper bonding and grounding. Correct improper bonding and grounding.
 - d. Inspect conductors for discoloration, arcing, pitting, melting, flaking of insulation and/or metal parts. Repair or replace damaged components in accordance with the manufacturer's recommendations.
 - e. Inspect for frayed or broken wires. Replace or repair damaged components in accordance with manufacturer recommendations.
 - f. Inspect for frayed or broken wires. Replace or repair conductors as necessary.
 - g. Inspect conduits for moisture. Seal conduits which are a source of moisture and provide means to drain moisture away from the panelboard.

5. Circuit breakers:
 - a. Perform visual and mechanical inspection as specified in this Section.
 - b. Operate several times in order to exercise the mechanisms and the contacts, and to ensure smooth operation. Do not oil or grease parts of molded case circuit breakers.
 - c. Visually check for evidence of overheating and thermal damage. Investigate and eliminate sources of overheating.
 - d. Check for visual defects, chipping, cracks, breaks, burns, and deterioration. Replace damaged circuit breakers.
 - e. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
 - f. Inspect interchangeable trip-unit circuit breakers for tightness of trip units.
 - g. Check terminals and connections for tightness as specified above.
 - h. Breakers rated 100 A and above:
 - 1) Perform electrical tests as specified in this Section.
- D. Switchgear and switchboard:
 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding and required area clearances.
 - d. Verify the unit is clean and shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.
 - e. Verify that circuit breaker/fuse sizes and types correspond to the approved Submittals and the coordination study as well as to the circuit breakers address for microprocessor-communication packages.
 - f. Verify that current and voltage transformer ratios correspond to those indicated on the Drawings.
 - g. Verify that wiring connections are tight and that wiring is secure to prevent damage during routine operation of moving parts.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - i. Verify operation and sequencing of interlocking systems:
 - 1) Attempt closure on locked-open devices.
 - 2) Attempt to open locked-closed devices.
 - 3) Make/attempt key-exchanges in all positions.
 - j. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - k. Inspect insulators for evidence of physical damage or contaminated surfaces.
 - l. Verify correct barrier and shutter installation and operation.
 - m. Exercise active components.
 - n. Inspect mechanical indicating devices for correct operation.
 - o. Verify that filters are in place and/or vents are clear.

- p. Perform visual and mechanical inspection of instrument transformers as specified in this Section.
 - q. Perform visual and mechanical inspection of surge arresters as specified in this Section.
 - r. Control power transformers:
 - 1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse/circuit breaker ratings match the Submittal Drawings.
 - 3) Verify correct functioning of drawout disconnecting contacts grounding contacts, and interlocks.
2. Electrical tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for 1 minute.
 - 1) Perform test in accordance with NETA ATS tables.
 - c. Perform electrical tests on instrument transformers as specified in this Section.
 - d. Perform ground-resistance tests:
 - 1) Perform point-to-point tests to determine the resistance between the main grounding system and major electrical equipment frames, system neutral and derived neutral points.
 - e. Test metering devices as specified in this Section.
 - f. Control power transformers:
 - 1) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground:
 - a) Test voltages shall be in accordance with NETA ATS tables or as specified by the manufacturer.
 - b) Perform a turns-ratio test on all tap positions.
 - 2) Perform secondary wiring integrity test:
 - a) Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source:
 - (1) Verify correct potential at all devices.
 - 3) Verify correct secondary voltage by energizing primary winding with system voltage:
 - a) Measure secondary voltage with the secondary wiring disconnected.
 - 4) Verify correct function of control power transfer relays located in switchgear with multiple control power sources.
 - g. Perform current injection tests on the entire current circuit of each switchgear or switchboard:
 - 1) Perform current tests by secondary injection with magnitudes such that a minimum current of 1.0 amp flows in the secondary circuit:
 - a) Verify the correct magnitude of current at each device in the circuit.
 - h. Perform system function tests.
 - i. Verify operation of space heaters.
 - j. Perform electrical tests of surge arresters as specified in this Section.

3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation-resistance values of bus insulation shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate insulation values less than the allowable minimum.
 - 3) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
 - d. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
 - e. Insulation-resistance values of control wiring shall not be less than 2 megohms.
 - f. Instrument transformer test values shall be as specified in this Section.
 - g. Meter test values shall be as specified in this Section.
 - h. Investigate grounding system point-to-point resistance values that exceed 0.5 ohm.
 - i. Control power transformers:
 - 1) Insulation-resistance values of control power transformers shall be in accordance with the manufacturer's published data:
 - a) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - b) Investigate insulation values less than the allowable minimum.
 - 2) Turns-ratio test results shall not deviate by more than 1/2 percent from either the adjacent coils or the calculated ratio.
 - a) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
 - 3) Secondary wiring shall be as indicated on the Drawings and specified in the Specifications.
 - 4) Secondary voltage shall be as indicated on the Drawings.
 - 5) Control transfer relays shall perform as designed.
 - j. Current-injection tests shall prove current wiring is as indicated on the Drawings and specified in the Specifications.
 - k. Results of system function tests shall match the Drawings and Specifications.
 - l. Heaters shall be operational.
 - m. Phasing checks shall prove the switchgear or switchboard phasing is correct and in accordance with the system design.
 - n. Results of electrical tests on surge arresters shall be as specified in this Section.

- E. Dry type transformers:
1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify that resilient mounts are free and that any shipping brackets have been removed.
 - e. Inspect equipment for cleanliness.
 - f. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - g. Verify that as-left tap connections are as specified.
 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground:
 - 1) Apply voltage in accordance with the manufacturer's published data.
 - a) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Calculate dielectric absorption ratio or polarization index.
 - d. Perform turns ratio tests at all tap positions.
 - e. Verify correct secondary voltage, phase-to-phase and phase-to-neutral after energization and before loading.
 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Tap connections are left as found unless otherwise specified.
 - d. Minimum insulation-resistance values of transformer insulation shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate insulation values less than the allowable minimum.
 - e. Dielectric absorption ratio or polarization index shall not be less than 1.0.
 - f. Turns-ratio results should not deviate more than 1/2 percent from either the adjacent coils or calculated ratio.
 - g. Phase-to-phase and phase-to-neutral secondary voltages shall be in agreement with nameplate data.

F. Liquid-filled transformers:

1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect impact recorder before unloading.
 - d. Test dew point of tank gases, if applicable.
 - e. Inspect anchorage, alignment, grounding and required clearances.
 - f. Verify the presence of PCB content labeling.
 - g. Verify removal of any shipping bracing after placement.
 - h. Verify the bushings are clean.
 - i. Verify that alarm, control and trip settings on temperature and level indicators are as specified.
 - j. Verify operation of alarm, control, and trip circuits from temperature and level indicators, pressure relief device, gas accumulator, and fault pressure relay, if applicable.
 - k. Verify that cooling fans operate correctly and that fan motors have correct overcurrent protection.
 - l. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - m. Verify correct liquid level in tanks and bushings.
 - n. Verify valves are in the correct operating position.
 - o. Verify that positive pressure is maintained on gas-blanketed transformers.
 - p. Perform inspections and mechanical tests as recommended by the manufacturer.
 - q. Test load tap-changer in accordance with NETA ATS requirements.
 - r. Verify presence of transformer surge arresters.
 - s. Verify de-energized tap-changer position is left as specified.
2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground:
 - 1) Apply voltage in accordance with the manufacturer's published data:
 - a) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Calculate polarization index.
 - c. Perform turns ratio tests at all tap positions.
 - d. Perform insulation power-factor or dissipation-factor tests on windings in accordance with the test equipment manufacturer's published data.
 - e. Perform power-factor or dissipation-factor tests on each bushing equipped with a power-factor/capacitance tap:
 - 1) In the absence of a power-factor/capacitance tap, perform hot-collar tests.
 - 2) Perform tests in accordance with the test equipment manufacturer's published data.

- f. Perform excitation-current tests in accordance with the test equipment manufacturer's published data.
 - g. Perform sweep frequency response analysis tests.
 - h. Measure the resistance of each primary winding in each no-load tap changer position. Measure the resistance of each secondary winding in each no-load tap changer position.
 - i. Remove a sample of insulating liquid in accordance with ASTM D923 and test in accordance with the following standards:
 - 1) Dielectric breakdown voltage: ASTM D877 or ASTM D1816.
 - 2) Acid neutralization number: ASTM D974.
 - 3) Specific gravity: ASTM D1298.
 - 4) Interfacial tension: ASTM D971.
 - 5) Color: ASTM D1500.
 - 6) Visual condition: ASTM D1524.
 - 7) Water in insulating fluids: ASTM D1533.
 - 8) Power-factor or dissipation-factor: ASTM D924.
 - j. Remove a sample of insulating liquid in accordance with ASTM D924. Sample shall be tested for the following:
 - 1) Dissolved-gas analysis: IEEE C57.104 or ASTM D3612.
 - k. Test instrument transformers as specified in this Section.
 - l. Test surge arresters as specified in this Section, if applicable.
 - m. Test transformer neutral grounding impedance device, if applicable.
 - n. Verify operation of cubicle or air terminal compartment space heaters.
3. Test values:
- a. Alarm control and trip circuits from temperature and level indicators, as well as pressure relief device and fault pressure relay, shall operate within the manufacturer's recommendations for their specified settings.
 - b. Cooling fans and pumps shall operate.
 - c. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - d. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - e. Liquid levels in the transformer tanks and bushings shall be within indicated tolerances.
 - f. Positive pressure shall be indicated on pressure gauge for gas-blanketed transformers.
 - g. Minimum insulation-resistance values of transformer insulation shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate insulation values less than the allowable minimum.
 - h. Polarization index shall be greater than 1.0:
 - 1) Compare to any previous values.
 - i. Turns-ratio test result shall not deviate by more than 1/2 percent from either the adjacent coils or the calculated ratio.

- j. Maximum winding insulation power-factor/dissipation-factor values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - k. Investigate bushing power-factor values that vary from nameplate values by more than 150 percent. Investigate bushing capacitance values that vary from nameplate values by more than 5 percent. Investigate bushing hot-collar test values that exceed 0.1 watts.
 - l. Typical excitation-current test data pattern for a 3-legged core transformer is 2 similar current readings and 1 lower current reading.
 - m. Sweep frequency response analysis test results shall be comparable to previously obtained results.
 - n. Consult the manufacturer if winding-resistance test values vary by more than 2 percent from factory test values or between adjacent phases.
 - o. Investigate leakage reactance per phase test results that deviate from the average of the 3 readings by more than 3 percent. 3 phase equivalent test results serve as a benchmark for future tests.
 - p. Core insulation values shall be comparable to previously obtained results but not be less than 1.0 megohm at 500 VDC.
 - q. Investigate the presence of oxygen in the nitrogen gas blanket.
 - r. Insulating liquid values shall be in accordance with NETA ATS tables.
 - s. Evaluate results of dissolved-gas analysis in accordance with IEEE C57.104.
 - t. Results of electrical tests on instrument transformers shall be as specified in this Section.
 - u. Results of surge arrester tests shall be as specified in this Section.
 - v. Compare grounding impedance device results to the manufacturer's published data.
 - w. Heaters shall be operational.
- G. Low voltage cables, 600 volt maximum:
- 1. Visual and mechanical inspection:
 - a. Compare cable data with the Drawings and Specifications.
 - b. Inspect exposed sections of cable for physical damage and correct connection as indicated on the Drawings.
 - c. Inspect bolted electrical connections for high resistance by one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - d. Inspect compression applied connectors for correct cable match and indentation.
 - e. Inspect for correct identification and arrangement.
 - f. Inspect cable jacket insulation and condition.
 - 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

- b. Perform insulation resistance test on each conductor sized #8 AWG or larger with respect to ground and adjacent conductors:
 - 1) Applied potential shall be 500 volts DC for 300-volt rated cable and 1,000 volts DC for 600-volt rated cable.
 - 2) Test duration shall be 1 minute.
 - c. Perform continuity tests on power and control conductors to ensure correct cable connection.
 - d. Verify uniform resistance of parallel conductors.
 - 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate values of insulation-resistance less than the allowable minimum.
 - c. Cable shall exhibit continuity.
 - d. Deviations in resistance between parallel conductors shall be investigated.
- H. Medium voltage cables:
 - 1. Visual and mechanical inspection:
 - a. Compare cable data with the Contract Documents.
 - b. Inspect exposed sections of cables for physical damage.
 - c. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - d. Inspect compression-applied connectors for correct cable match and indentation.
 - e. Inspect shield grounding, cable support, and terminations.
 - f. Verify the visible bends meet or exceed ICEA and the manufacturer's published minimum allowable bending radius.
 - g. Inspect fireproofing in common cable areas.
 - h. If cables are terminated through window-type current transformers, inspect to verify that neutral and ground conductors are correctly placed and that shields are correctly terminated for operation of protective devices.
 - i. Inspect for correct identification and arrangements.
 - j. Inspect jacket insulation and condition.
 - 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with low-resistance ohmmeter.

- b. Perform an insulation-resistance test individually on each conductor with all other conductors and shields grounded:
 - 1) Apply voltage in accordance with the manufacturer's published data:
 - a) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Perform shield-continuity test on each power cable.
 - d. Perform cable and time domain reflectometer (TDR) measurements on each conductor.
 - e. In accordance with ICEA, IEC, IEEE, and other power cable consensus standards, testing can be performed by means of direct current, power frequency alternating current, very low frequency alternating current, or damped alternating current.
 - 1) These sources may be used to perform insulation-resistance tests and baseline diagnostic tests such as partial discharge analysis, and power factor or power dissipation factor.
 - 2) Selection shall be made after an evaluation of the available test methods and a review of the installed cable system.
 - 3) Some of available test methods are as follows:
 - a) Dielectric withstand:
 - (1) Direct current dielectric withstand voltage.
 - (2) Very low frequency dielectric withstand voltage.
 - (3) Power frequency dielectric withstand voltage.
 - (4) Damped alternating current voltage.
 - b) Baseline diagnostic tests:
 - (1) Power factor/dissipation factor (tan delta):
 - (a) Power frequency.
 - (b) Very low frequency.
 - (2) Direct current insulation-resistance.
 - (3) Partial discharge:
 - (a) Online (50/60 hertz).
 - (b) Offline:
 - Power frequency.
 - Very low frequency.
- 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Minimum bend radius to which insulated cables may be bent for permanent training shall be in accordance with NETA ATS tables.
 - d. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate values of insulation-resistance less than the allowable minimum.

- e. Shielding shall exhibit continuity:
 - 1) Investigate resistance values in excess of 10 ohms per 1,000 feet of cable.
 - f. If no evidence of distress of insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
 - g. Based on the test methodology chosen, refer to the applicable standards or manufacturer's literature for acceptable values.
- I. Metal enclosed bus duct:
- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspected physical and mechanical condition.
 - c. Inspect for proper bracing, suspension alignment, and grounding.
 - d. Verify correct connection in accordance with the one-line diagrams.
 - e. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of bolted connections and bus joints by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - f. Confirm physical orientation in accordance with the manufacturer's labels to ensure adequate cooling.
 - 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections and bus joints with a low-resistance ohmmeter.
 - b. Measure insulation-resistance of each busway, phase-to-phase and phase-to-ground for 1 minute, in accordance with NETA ATS tables.
 - c. Perform a dielectric withstand voltage test on each busway, phase-to-ground with phases not under test grounded, in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Where no DC test value is shown in the NETA ATS tables, AC value shall be used.
 - 3) Test voltage shall be applied for 1 minute.
 - d. Measure resistance of assembled busway sections on insulated busway and compare values with adjacent phases:
 - 1) Compare values with adjacent phases.
 - e. Perform phasing test on each busway tie section energized by separate sources. Tests must be performed from their permanent sources.
 - f. Verify operation of busway space heaters.
 - g. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - h. Bolt-torque levels should be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.

3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Insulation-resistance test voltages and resistance values shall be in accordance with the manufacturer's published:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Minimum resistance values are for a nominal 1,000-foot busway run. Use the following formula to convert the measured resistance value to the 1,000-foot nominal value:

$$R_{1000ft} = \text{Measured Resistance} \times \frac{\text{Length of run}}{1000}$$

Converted values of insulation-resistance less than those in NETA ATS tables or the manufacturer's minimum should be investigated.

- 3) Dielectric withstand voltage tests shall not proceed until insulation-resistance levels are raised above minimum values.
 - c. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
 - d. Micro-ohm or DC millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
 - 1) If the manufacturer's published data is not available, investigate values which deviate from those of similar bus connections and sections by more than 50 percent of the lowest value.
 - e. Phasing test results shall indicate the phase relationships are in accordance with system design.
 - f. Heaters shall be operational.
- J. Low voltage molded case and insulated case circuit breakers:
1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage and alignment.
 - d. Verify the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.
 - f. Inspect bolted electrical connections for high resistance by one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - g. Perform adjustments for final protective device settings in accordance with the coordination study.
 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

- b. For new breakers 100 A and above , and for existing circuit breakers, regardless of size, to be used as part of the Project:
 - 1) Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed, and across each open pole:
 - a) Apply voltage in accordance with the manufacturer's published data.
 - b) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Perform a contact/pole-resistance test.
 - 3) Perform insulation-resistance tests on control wiring with respect to ground.
 - a) Applied potential shall be in accordance with the manufacturer's instructions, or 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable if not defined by the manufacturer.
 - b) Apply the test voltage for 1 minute:
 - (1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
 - 4) Determine long-time pickup and delay by primary current injection.
 - 5) Determine short-time pickup and delay by primary current injection.
 - 6) Determine ground-fault pickup and delay by primary current injection.
 - 7) Determine instantaneous pickup value by primary current injection.
 - 8) Test functions of the trip unit by means of secondary injection.
 - 9) Perform minimum pickup voltage tests on shunt trip and close coils in accordance with the manufacturer's published data.
 - 10) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function and trip unit battery condition:
 - a) Reset trip logs and indicators.
 - 11) Verify operation of charging mechanism.
- 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate values of insulation-resistance less than the allowable minimum.
 - d. Micro-ohm or DC millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
 - 1) If the manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

- e. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed the manufacturer's published time-current characteristic tolerance band, including adjustment factors:
 - 1) If the manufacturer's curves are not available, trip times shall not exceed the value shown in NETA ATS tables.
 - f. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed the manufacturer's published time-current tolerance band.
 - g. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed the manufacturer's published time-current tolerance band.
 - h. Instantaneous pickup values shall be as specified and within the manufacturer's published tolerances:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - i. Pickup values and trip characteristics shall be within the manufacturer's published tolerances.
 - j. Determine energy reducing maintenance switch pickup value by primary current injection.
 - k. Breaker open, close, trip, trip-free, anti-pump, and auxiliary features shall function as designed.
 - l. Charging mechanism shall operate in accordance with the manufacturer's published data.
- K. Low voltage air power circuit breakers - ANSI class breakers:
- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify that maintenance devices are available for servicing and operating the breaker.
 - e. Verify the unit is clean.
 - f. Verify the arc chutes are intact.
 - g. Inspect moving and stationary contacts for condition and alignment.
 - h. Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.
 - i. Perform mechanical operator and contact alignment tests on both the breaker and its operating mechanism in accordance with the manufacturer's published data.
 - j. Inspect bolted electrical connections for high resistance by one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - k. Verify cell fit and element alignment.
 - l. Verify racking mechanism operation.
 - m. Lubrication requirements:
 - 1) Verify appropriate lubrication on moving current-carrying parts.
 - 2) Verify appropriate lubrication on moving and sliding surfaces.
 - n. Perform adjustments for final protective device settings in accordance with the coordination study.

- o. Record as-found and as-left operation counter readings.
- 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed, and across each open pole:
 - 1) Test voltage shall be in accordance with the manufacturer's published data.
 - 2) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Perform a contact/pole-resistance test.
 - d. Determine long-time pickup and delay by primary current injection.
 - e. Determine short-time pickup and delay by primary current injection.
 - f. Determine ground-fault pickup and delay by primary current injection.
 - g. Determine instantaneous pickup value by primary current injection.
 - h. Determine energy reducing maintenance switch pickup value by primary current injection.
 - i. Test functions of the trip unit by means of secondary injection.
 - j. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with the manufacturer's published data.
 - k. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function and trip unit battery condition:
 - 1) Reset trip logs and indicators.
 - l. Verify operation of charging mechanism.
- 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Settings shall comply with coordination study requirements.
 - d. Operations counter shall advance 1 digit per close-open cycle.
 - e. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate values of insulation-resistance less than the allowable minimum.
 - f. Micro-ohm or DC millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
 - 1) If the manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

- g. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed the manufacturer's published time-current characteristic tolerance band, including adjustment factors:
 - 1) If the manufacturer's curves are not available, trip times shall not exceed the value shown in NETA ATS tables.
 - h. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed the manufacturer's published time-current tolerance band.
 - i. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed the manufacturer's published time-current tolerance band.
 - j. Instantaneous pickup values shall be as specified and within the manufacturer's published tolerances:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - k. Pickup values and trip characteristics shall be within the manufacturer's published tolerances.
 - l. Minimum pickup voltage of the shunt trip and close coils shall conform to the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - m. Auxiliary features shall operate in accordance with the manufacturer's published data.
 - n. Charging mechanism shall operate in accordance with the manufacturer's published data.
- L. Medium voltage vacuum circuit breakers:
- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage and alignment and grounding.
 - d. Verify that maintenance devices, such as special tools and gauges specified by the manufacturer, are available for servicing and operating the breaker.
 - e. Verify the unit is clean.
 - f. Perform mechanical operation tests on the operating mechanism in accordance with the manufacturer's published data.
 - g. Measure critical distances such as contact gap as recommended by the manufacturer.
 - h. Inspect bolted electrical connections for high resistance by one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - i. Verify cell fit and element alignment.
 - j. Verify racking mechanism operation.
 - k. Perform time-travel analysis.
 - l. Lubrication requirements:
 - 1) Verify appropriate lubrication on moving current-carrying parts.
 - 2) Verify appropriate lubrication on moving and sliding surfaces.
 - m. Perform contact-timing test.

- n. Record as-found and as-left operation counter readings.
- 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed, and across each open pole:
 - 1) Test voltage shall be in accordance with the manufacturer's published data.
 - 2) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:
 - 1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
 - d. Perform a static contact/pole-resistance test.
 - e. Perform a dynamic contact/pole resistance test.
 - f. Perform minimum pickup voltage tests on trip and close coils in accordance with the manufacturer's published data.
 - g. Verify correct operation of any auxiliary features such as electrical close and trip operation, trip-free and anti-pump function.
 - h. Trip circuit breaker by operation of each protective device.
 - 1) Reset trip logs and indicators.
 - i. Perform vacuum bottle integrity (dielectric withstand) test across each vacuum bottle with the breaker in the open position in accordance with the manufacturer's published data. Do not exceed the maximum voltage stipulated for this test:
 - 1) Provide adequate barriers and protection against x-radiation during this test.
 - 2) Do not perform this test unless the contact displacement of each interrupter is within the manufacturer's published tolerance.
 - 3) Be aware that some DC high-potential test sets are half-wave rectified and may produce peak voltages in excess of the breaker manufacturer's recommended maximum.
 - j. Perform a dielectric withstand voltage test in accordance with the manufacturer's published data.
 - k. Verify operation of heaters.
 - l. Test instrument transformers as specified in this Section.
- 3. Test values:
 - a. Critical distance measurements such as contact gap shall be in accordance with the manufacturer's published data.
 - b. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - c. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.

- d. Contact timing values shall be in accordance with the manufacturer's published data.
- e. Trip/close coil current values shall be in accordance with the manufacturer's published data.
- f. Travel and velocity values shall be in accordance with the manufacturer's published data.
- g. Operations counter shall advance 1 digit per close-open cycle.
- h. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate values of insulation-resistance less than the allowable minimum.
- i. Insulation-resistance values of control wiring shall not be less than 2 megohms.
- j. Micro-ohm or DC millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
 - 1) If the manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.
- k. Dynamic contact resistance values shall be in accordance with the manufacturer's published data.
- l. Minimum pickup voltage of the trip and close coils shall conform to the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
- m. Auxiliary features shall operate in accordance with the manufacturer's published data.
- n. Protective devices shall operate the breaker per system design.
- o. Power-factor or dissipation-factor values shall be compared to the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, the comparison shall be made to similar breakers.
- p. Power-factor or dissipation-factor and capacitance values shall be within 10 percent of nameplate ratings for bushings. Hot collar tests are evaluated on a milliampere/milliwatt loss basis and the results shall be compared to values of similar bushings.
- q. If no evidence of distress of insulation failure is observed by the end of the total time of voltage application during the vacuum bottle integrity test, the test specimen is considered to have passed the test.
- r. If no evidence of distress of insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
- s. Heaters shall be operational.
- t. Results of instrument transformer tests shall be as specified in this Section.

M. Protective relays, microprocessor based:

- 1. Visual and mechanical inspection:
 - a. Record model number, style number, serial number, firmware revision, software revision and rated control voltage.
 - b. Verify operation of light-emitting diodes, display, and targets.

- c. Record passwords for all access levels.
 - d. Clean the front panel and remove foreign material from the case.
 - e. Check tightness of connections.
 - f. Verify that the frame is grounded in accordance with the manufacturer's instructions.
 - g. Set the relay in accordance with the coordination study.
 - h. Download settings from the relay. Print a copy of the settings for the report and compare the settings to those specified in the coordination study.
 - i. Connect back-up battery.
 - j. Set clock if not controlled externally.
 - k. Check with the manufacturer for applicable firmware updates and product recalls.
 - l. Inspect, clean and verify operation of shorting devices.
2. Electrical tests:
- a. Perform insulation-resistance tests from each circuit to the grounded frame in accordance with the manufacturer's published data.
 - b. Apply voltage or current to analog inputs and verify correct registration of the relay meter functions.
 - c. Verify SCADA metering values at remote terminals.
 - d. Functional operation:
 - 1) Check functional operation of each element used in the protection scheme.
 - 2) 2/62 timing relay:
 - a) Determine time delay.
 - b) Verify operation of instantaneous contacts.
 - 3) 21 distance relay:
 - a) Determine maximum reach.
 - b) Determine maximum torque angle.
 - c) Determine offset.
 - d) Plot impedance circle.
 - 4) 24 volts/hertz relay:
 - a) Determine pickup frequency at rated voltage.
 - b) Determine pickup frequency at a second voltage level.
 - c) Determine time delay.
 - 5) 25 sync check relay:
 - a) Determine closing zone at rated voltage.
 - b) Determine maximum voltage differential that permits closing at zero degrees.
 - c) Determine live line, live bus, dead line, and dead bus setpoints.
 - d) Verify dead bus/live line, dead line/live bus and dead bus/dead line control functions.
 - e) Determine time delay.
 - 6) 27 undervoltage relay:
 - a) Determine dropout voltage.
 - b) Determine time delay.
 - c) Determine time delay at a second point on the timing curve for inverse time relays.
 - 7) 32 directional power relay:
 - a) Determine minimum pickup at maximum torque angle.
 - b) Determine closing zone.
 - c) Determine maximum torque angle.

- d) Determine time delay.
- e) Verify time delay at a second point on the timing curve for inverse time relays.
- f) Plot the operating characteristic.
- 8) 40 loss of field (impedance) relay:
 - a) Determine maximum reach.
 - b) Determine maximum torque angle.
 - c) Determine offset.
 - d) Plot impedance circle.
- 9) 46 current balance relay:
 - a) Determine pickup of each unit.
 - b) Determine percent slope.
 - c) Determine time delay.
- 10) 46N negative sequence current relay:
 - a) Determine negative sequence alarm level.
 - b) Determine negative sequence minimum trip level.
 - c) Determine maximum time delay.
 - d) Verify 2 points on the $(I_2)^2t$ curve.
- 11) 47 phase sequence or phase balance voltage relay:
 - a) Determine positive sequence voltage to close the normally open contact.
 - b) Determine positive sequence voltage to open the normally closed contact (undervoltage trip).
 - c) Verify negative sequence trip.
 - d) Determine time delay to close the normally open contact with sudden application of 120 percent of pickup.
 - e) Determine time delay to close the normally closed contact upon removal of voltage when previously set to rated system voltage.
- 12) 49R thermal replica relay:
 - a) Determine time delay at 300 percent of setting.
 - b) Determine a second point on the operating curve.
 - c) Determine pickup.
- 13) 49T temperature (RTD) relay:
 - a) Determine trip resistance.
 - b) Determine reset resistance.
- 14) 50 instantaneous overcurrent relay:
 - a) Determine pickup.
 - b) Determine dropout.
 - c) Determine time delay.
- 15) 51 time overcurrent:
 - a) Determine minimum pickup.
 - b) Determine time delay at 2 points on the time current curve.
- 16) 55 power factor relay:
 - a) Determine tripping angle.
 - b) Determine time delay.
- 17) 59 overvoltage relay:
 - a) Determine overvoltage pickup.
 - b) Determine time delay to close the contact with sudden application of 120 percent of pickup.

- 18) 60 voltage balance relay:
 - a) Determine voltage difference to close the contacts with 1 source at rated voltage.
 - b) Plot the operating curve for the relay.
- 19) 63 transformer sudden pressure relay:
 - a) Determine rate-of-rise or the pickup level of suddenly applied pressure in accordance with the manufacturer's published data.
 - b) Verify operation of the 63 FPX seal-in circuit.
 - c) Verify trip circuit to remote operating device.
- 20) 64 ground detector relay:
 - a) Determine maximum impedance to ground causing relay pickup.
- 21) 67 directional overcurrent relay:
 - a) Determine directional unit minimum pickup at maximum torque angle.
 - b) Determine closing zone.
 - c) Determine maximum torque angle.
 - d) Plot operating characteristics.
 - e) Determine overcurrent unit pickup.
 - f) Determine overcurrent unit time delay at 2 points on the time current curve.
- 22) 79 reclosing relay:
 - a) Determine time delay for each programmed reclosing interval.
 - b) Verify lockout for unsuccessful reclosing.
 - c) Determine reset time.
 - d) Determine close pulse duration.
 - e) Verify instantaneous overcurrent lockout.
- 23) 81 frequency relay:
 - a) Verify frequency setpoints.
 - b) Determine time delay.
 - c) Determine undervoltage cutoff.
- 24) 85 pilot wire monitor:
 - a) Determine overcurrent pickup.
 - b) Determine undercurrent pickup.
 - c) Determine pilot wire ground pickup level.
- 25) 87 differential:
 - a) Determine operating unit pickup.
 - b) Determine the operation of each restraint unit.
 - c) Determine slope.
 - d) Determine harmonic restraint.
 - e) Determine instantaneous pickup.
 - f) Plot operating characteristics for each restraint.
- e. Control verification:
 - 1) Functional tests:
 - a) Check operation of active digital inputs.
 - b) Check output contacts or SCRs preferably by operating the controlled device such as circuit breaker, auxiliary relay or alarm.
 - c) Check internal logic functions used in the protection scheme.
 - d) For pilot schemes, perform a loop-back test to check the receive and transmit communications circuits.

- e) Upon completion of testing, reset min/max recorders, communications statistics, fault counters, sequence of events recorder, and event records.
- f) Verify trip and close coil monitoring functions.
- g) Verify setting change alarm to SCADA.
- h) Verify relay SCADA communication and indications such as protection operate, protection fail, communication fail, fault recorder trigger.
- i) Verify communication links are operational.
- j) Light-emitting diodes, displays and targets should illuminate.
- k) Relay should be clean and operational.
- l) Settings and logic should agree with the most recent engineering files.
- m) Verify relay displays the correct date and time.
- 2) Insulation-resistance values should be in accordance with the manufacturer's published data.
 - a) Investigate values of insulation resistance less than the manufacturer's recommendation.
- 3) Voltage and current analog readings should be in accordance with the manufacturer's published tolerances.
- 4) SCADA readings should be in accordance with the manufacturer's published tolerances.
- 5) Operation of protection elements should be within the manufacturer's published tolerances.
- 6) Control verification inputs, outputs, and protection schemes should operate in accordance with the design. Results should be within the manufacturer's published tolerances.

N. Instrument transformers - current transformers:

- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Verify correct connection of transformers with system requirements.
 - d. Verify that adequate clearances exist between primary and secondary circuit wiring.
 - e. Verify the unit is clean.
 - f. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - g. Verify that required grounding and shorting connections provide contact.
 - h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
- 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

- b. Perform insulation-resistance test of each current transformer and its secondary wiring with respect to ground at 1,000 VDC for 1 minute:
 - 1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
 - c. Perform a polarity test of each current transformer in accordance with IEEE C57.13.1.
 - d. Perform a ratio verification test using the voltage or current method in accordance with IEEE C57.13.1.
 - e. Perform an excitation test on current transformers used for relaying applications in with accordance with IEEE C57.13.1.
 - f. Measure current circuit burdens at transformer terminals in accordance with IEEE C57.13.1.
 - g. When applicable, perform insulation-resistance tests on the primary winding with the secondary grounded:
 - 1) Test voltages shall be in accordance with NETA ATS tables.
 - h. When applicable, perform dielectric withstand tests on the primary winding with the secondary grounded:
 - 1) Test voltages shall be in accordance with NETA ATS tables.
 - i. Perform power-factor or dissipation-factor tests in accordance with the test equipment manufacturer's published data.
 - j. Verify that current transformer secondary circuits are grounded and have only 1 grounding point in accordance with IEEE C57.13.3:
 - 1) That grounding point should be located as specified by the Engineer in the Contract Documents.
3. Test values:
- a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation-resistance values of instrument transformers shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - d. Polarity results shall agree with transformer markings.
 - e. Ratio errors shall be in accordance with IEEE C57.13.
 - f. Excitation results for current transformers shall match the curve supplied by the manufacturer or be in accordance with IEEE C57.13.1.
 - g. Measured burdens shall be compared to instrument transformer ratings.
 - h. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the primary winding is considered to have passed the test.
 - i. Power-factor or dissipation-factor values shall be compared to the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, use the test equipment manufacturer's published data.
 - j. Test results shall indicate that the circuits have only 1 grounding point.

- O. Instrument transformers - voltage transformers:
1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Verify correct connection of transformers with system requirements.
 - d. Verify that adequate clearances exist between primary and secondary circuit wiring.
 - e. Verify the unit is clean.
 - f. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - g. Verify that required grounding and connections provide contact.
 - h. Verify correct primary and secondary fuse sizes for voltage transformers.
 - i. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - j. Perform as-left tests.
 2. Electrical tests - voltage transformers:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests winding-to-winding and winding-to-ground:
 - 1) Test voltage shall be applied for 1 minute in accordance with NETA ATS requirements.
 - 2) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
 - c. Perform a polarity test on each voltage transformer to verify the polarity marks on H₁- X₁ relationship as applicable.
 - d. Perform a turns ratio test on all tap positions.
 - e. Measure voltage circuit burdens at transformer terminals.
 - f. Perform a dielectric withstand test on the primary windings with the secondary windings grounded:
 - 1) Dielectric voltage shall be in accordance with NETA ATS tables.
 - 2) Apply the test voltage for 1 minute.
 - g. Perform power-factor or dissipation-factor tests in accordance with the test equipment manufacturer's published data.
 - h. Verify that voltage transformer secondary circuits are grounded and have only 1 grounding point in accordance with IEEE C57.13.3:
 - 1) That grounding point should be located as specified by the Engineer in the Contract Documents.
 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

- b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation-resistance values of instrument transformers shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - d. Polarity results shall agree with transformer markings.
 - e. Ratio errors shall be in accordance with IEEE C57.13.
 - f. Measured burdens shall be compared to instrument transformer ratings.
 - g. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the primary winding is considered to have passed the test.
 - h. Power-factor or dissipation-factor values shall be compared to the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, use the test equipment manufacturer's published data.
 - i. Test results shall indicate that the circuits have only 1 grounding point.
- P. Metering devices, microprocessor based:
 - 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect meters and cases for physical damage.
 - c. Clean front panel.
 - d. Verify tightness of electrical connections.
 - e. Record the following:
 - 1) Model number.
 - 2) Serial number.
 - 3) Firmware revision.
 - 4) Software revision.
 - 5) Rated control voltage.
 - f. Verify operation of display and indicating devices.
 - g. Record passwords.
 - h. Verify the unit is grounded in accordance with the manufacturer's instructions.
 - i. Set required parameters, including instrument transformer ratios, system type, frequency, power demand methods/intervals, and communications requirements.
 - 2. Electrical tests:
 - a. Apply voltage or current as appropriate to each analog input and verify correct measurement and indication.
 - b. Confirm correct operation and setting of each auxiliary input/output feature, including mechanical relay, digital and analog.
 - c. After initial system energization, confirm measurements and indications are consistent with loads present.
 - 3. Test values:
 - a. Nameplate data shall match the Contract Documents.
 - b. Tightness of electrical connections shall ensure a low resistance connection.

- c. Display and indicating devices shall operate in accordance with the manufacturer's published data.
- d. Measurement and indication of applied voltages and currents shall be within the manufacturer's published tolerances for accuracy.
- e. Auxiliary input/output features shall operate in accordance with the settings and the manufacturer's published data.
- f. Measure and indications shall be consistent with energized system loads.

Q. Grounding systems:

- 1. Visual and mechanical inspection:
 - a. Inspect ground system for compliance with the Contract Documents and the NEC.
 - b. Inspect physical and mechanical condition.
 - c. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - d. Inspect anchorage.
- 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform fall of potential test or alternative test in accordance with IEEE 81 on the main grounding electrode or system.
 - c. Perform point-to-point tests to determine the resistance between the main grounding system and major electrical equipment frames, the system neutral and any derived neutral points.
- 3. Test values:
 - a. Grounding system electrical and mechanical connections shall be free of corrosion.
 - b. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - c. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - d. Resistance between the main grounding electrode and ground shall be as specified in Section 26_05_26 - Grounding and Bonding.
 - e. Investigate point-to-point resistance values that exceed 0.5 ohm.

R. Rotating machinery, AC induction motors and generators:

- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate information with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging.

- e. Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - f. Manually rotate the rotor and check for problems with the bearings or shaft.
 - g. Rotate the shaft and measure and record the shaft extension runout.
 - h. Rotating equipment:
 - 1) Operate at rated design load conditions.
 - 2) Confirm that equipment is properly assembled.
 - 3) Confirm the equipment moves or rotates in the proper direction.
 - 4) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
 - 5) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
 - i. Verify correct application of appropriate lubrication and lubrication systems.
 - j. Verify that resistance temperature detector (RTD) circuits conform to that indicated on the Drawings.
2. Electrical tests - AC induction:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance test in accordance with IEEE 43:
 - 1) On motors 200 horsepower and smaller, test duration shall be 1 minute. Calculate dielectric absorption ratio for 60/30-second periods.
 - 2) On motors larger than 200 horsepower, test duration shall be 10 minutes. Calculate polarization index.
 - c. On machines rated at 2,300 volts and greater, perform dielectric withstand voltage tests in accordance with:
 - 1) IEEE 95 for DC dielectric withstand voltage tests.
 - 2) NEMA MG1 for AC dielectric withstand voltage tests.
 - d. Perform phase-to-phase stator resistance test on machines rated at 2,300 volts and greater.
 - e. Perform insulation power-factor or dissipation-factor tests.
 - f. Perform power-factor tip-up tests.
 - g. Perform surge comparison tests.
 - h. Perform insulation-resistance test on insulated bearings in accordance with the manufacturer's published data.
 - i. Test surge protection devices as specified in this Section.
 - j. Test motor starter as specified in this Section.
 - k. Perform resistance tests on resistance temperature detector (RTD) circuits.
 - l. Verify operation of motor space heater, if applicable.
3. Test values:
- a. Inspection:
 - 1) Air baffles shall be clean and installed in accordance with the manufacturer's published data.
 - 2) Filter media shall be clean and installed in accordance with the manufacturer's published data.
 - 3) Cooling fans shall operate.

- 4) Slip ring alignment shall be within the manufacturer's published tolerances.
- 5) Brush alignment shall be within the manufacturer's published tolerances.
- 6) Brush rigging shall be within the manufacturer's published tolerances.
- b. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- c. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
- d. Airgap spacing and machine alignment shall be in accordance with the manufacturer's published data.
- e. Recommended minimum insulation-resistance ($IR_{1 \min}$) test results in megohms shall be in accordance with NETA ATS tables.
 - 1) Polarization index value shall not be less than 2.0.
 - 2) Dielectric absorption ratio shall not be less than 1.4.
- f. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
- g. Investigate phase-to-phase stator resistance values that deviate by more than 5 percent.
- h. Power factor or dissipation factor values shall be compared to the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, compare values of similar machines.
- i. Tip-up values shall indicate no significant increase in power factor.
- j. If no evidence of distress, insulation failure, or waveform nesting is observed by the end of the total time of voltage application during the surge comparison test, the test specimen is considered to have passed the test.
- k. Bearing insulation-resistance measurements shall be within manufacturer's published tolerances:
 - 1) In the absence of the manufacturer's published data, compare values of similar machines.
- l. Test results of surge protection devices shall be as specified in this Section.
- m. Test results of motor starter equipment shall be as specified in this Section.
- n. RTD circuits shall conform to the design intent and machine protection device manufacturer's published data.
- o. Heaters shall be operational.
- p. Vibration amplitudes of the uncoupled and unloaded machine shall be in accordance with the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, vibration amplitudes shall not exceed values in NETA ATS tables.
 - 2) If values exceed those in the NETA ATS tables, perform a complete vibration analysis.

S. Rotating machinery, synchronous motors and generators:

1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.

- b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging.
 - e. Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - f. Perform special tests such as airgap spacing and machine alignment.
 - g. Manually rotate the rotor and check for problems with the bearings or shaft.
 - h. Rotate the shaft and measure and record the shaft extension runout.
 - i. Rotating equipment:
 - 1) Operate at rated design load conditions.
 - 2) Confirm that equipment is properly assembled.
 - 3) Confirm the equipment moves or rotates in the proper direction.
 - 4) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
 - 5) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
 - j. Verify the application of appropriate lubrication and lubrication systems.
 - k. Verify that resistance temperature detector (RTD) circuits conform to that indicated on the Drawings.
2. Electrical tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests in accordance with IEEE 43.
 - 1) Machines larger than 200 horsepower (150 kilowatts):
 - a) Test duration shall be for 10 minutes. Calculate polarization index.
 - 2) Machines 200 horsepower (150 kilowatts) and less:
 - a) Test duration shall be for 1 minute. Calculate dielectric absorption ratio.
 - c. On machines rated at 2,300 volts and greater perform dielectric withstand voltage tests in accordance with:
 - 1) IEEE 95 for DC dielectric withstand voltage tests.
 - 2) NEMA MG1 for AC dielectric withstand voltage tests.
 - d. Perform phase-to-phase stator resistance test on machines 2,300 volts and greater.
 - e. Perform insulation-resistance test on insulated bearings in accordance with the manufacturer's published data.
 - f. Test surge protection devices as specified in this Section.
 - g. Test motor starter as specified in this Section.
 - h. Perform resistance tests on resistance temperature detector (RTD) circuits.
 - i. Verify operation of machine space heater, if applicable.
 - j. Perform vibration test while machine is running under load.
 - k. Perform insulation-resistance tests on the main rotating field winding, the exciter-field winding, and the exciter-armature winding in accordance with IEEE 43.

- l. Perform an AC voltage-drop test on rotating field poles.
 - m. Perform a high-potential test on the excitation system in accordance with IEEE 421.3.
 - n. Measure resistance of machine-field winding, exciter-stator winding, exciter-rotor windings, and field discharge resistors.
 - o. Perform front-to-back resistance tests on diodes and gating tests of silicon-controlled rectifiers for field application semiconductors.
 - p. Prior to re-energizing, apply voltage to the exciter supply and adjust exciter-field current to nameplate value.
 - q. Verify that the field application timer and the enable timer for the power-factor relay have been tested and set to the motor drive manufacturer's recommended values.
3. Test values:
- a. Inspection:
 - 1) Air baffles shall be clean and installed in accordance with the manufacturer's published data.
 - 2) Filter media shall be clean and installed in accordance with the manufacturer's published data.
 - 3) Cooling fans shall operate.
 - 4) Slip ring alignment shall be within the manufacturer's published tolerances.
 - 5) Brush alignment shall be within the manufacturer's published tolerances.
 - 6) Brush rigging shall be in accordance with the manufacturer's published data.
 - b. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate any values that deviate from similar bolted connections by more than 50 percent of the lowest value.
 - c. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - d. Airgap spacing and machine alignment shall be in accordance with the manufacturer's published data.
4. Test values - electrical:
- a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate any values that deviate from similar bolted connections by more than 50 percent of the lowest value.
 - b. Recommended minimum insulation-resistance ($IR_{1\text{ min}}$) test results in megohms shall be in accordance with NETA ATS tables.
 - 1) Polarization index value shall not be less than 2.0.
 - 2) Dielectric absorption ratio shall not be less than 1.4.
 - c. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
 - d. Investigate phase-to-phase stator resistance values that deviate by more than 5 percent.

- e. Power-factor or dissipation-factor values shall be compared to the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, the comparison shall be made to similar machines.
- f. Tip-up values shall indicate no significant increase in power factor or dissipation factor.
- g. If no evidence of distress, insulation failure, or lack of waveform nesting is observed by the end of the total time of voltage application during the surge comparison test, the test specimen is considered to have passed the test.
- h. Insulation-resistance of bearings shall be within the manufacturer's published tolerances:
 - 1) In the absence of the manufacturer's published tolerances, the comparison shall be made to similar machines.
- i. Test results of surge protection devices shall be as specified in this Section.
- j. Test results of motor starter equipment shall be as specified in this Section.
- k. RTD circuits shall be in accordance with the system design intent and machine protection device manufacturer's published data.
- l. Heaters shall be operational.
- m. Vibration amplitudes of the uncoupled and unloaded machine shall be in accordance with the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, vibration amplitudes shall not exceed values in NETA ATS tables.
 - 2) If values exceed those in NETA ATS tables, perform complete vibration analysis.
- n. Individual pole to pole AC voltage drop shall not exceed 10 percent variance from the average value (average value = test voltage divided by number of coils) applicable to all of the poles.
- o. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the winding is considered to have passed the test.
- p. Measured resistance values of motor-field windings, exciter-stator windings, exciter-rotor windings, and field-discharge resistors shall be compared to the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, the comparison shall be made to similar machines.
- q. Resistance test results of diodes and gating tests of silicon-controlled rectifiers shall be in accordance with industry standards and system design requirements.
- r. Exciter power supply shall allow exciter-field current to be adjusted to nameplate value.
- s. Application timer and enable timer for power-factor relay test results shall comply with the manufacturer's recommended values.
- t. Recorded values shall be in accordance with system design requirements.
- u. Plotted V-curve shall indicate correct exciter operation.
- v. When reduced excitation falls below trip value for the power-factor relay, the relay shall operate.

T. Motor control, motor starters, medium-voltage:

- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.

- c. Inspect anchorage, alignment, and grounding.
 - d. Verify the unit is clean.
 - e. Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - f. Test electrical and mechanical interlock systems for correct operation and sequencing.
 - g. Verify correct barrier and shutter installation and operation.
 - h. Exercise active components and confirm correct operation of indicating devices.
 - i. Inspect contactors:
 - 1) Verify mechanical operation.
 - 2) Verify contact gap, wipe, alignment, and pressure are in accordance with the manufacturer's published data.
 - j. Verify overload protection rating is correct for its application. Set adjustable or programmable devices according to the protective device coordination study.
 - k. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
2. Electrical tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests on contactor(s), phase-to-ground, phase-to-phase, and across the open contacts for 1 minute in accordance with NETA ATS tables.
 - c. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 volts DC for 300-volt rated cable and 1,000 volts DC for 600-volt rated cable. Test duration shall be 1 minute. For units with solid-state components, follow the manufacturer's recommendation.
 - d. Perform magnetron atmospheric condition (MAC) test on each vacuum interrupter.
 - e. Perform a dielectric withstand voltage test in accordance with the manufacturer's published data. In the absence of the manufacturer's published data, use NETA ATS requirements.
 - f. Perform vacuum bottle integrity test (dielectric withstand voltage), if applicable, across each vacuum bottle with the contacts in the open position in accordance with the manufacturer's published data. Do not exceed maximum voltage stipulated for this test.
 - g. Perform contact resistance tests.
 - h. Measure blowout coil circuit resistance.
 - i. Measure resistance of power fuses.
 - j. Energize contactor using an auxiliary source. Adjust armature to minimize operating vibration where applicable.
 - k. Test control power transformers as specified in this Section.
 - l. Test starting transformers, if applicable, as specified in accordance with NETA ATS.

- m. Test starting reactors, if applicable, in accordance with NETA ATS.
 - n. Test motor protection devices in accordance with the manufacturer's published data. In the absence of the manufacturer's published data.
 - o. Perform system function test as specified in this Section.
 - p. Verify operation of cubicle space heater.
 - q. Test instrument transformers as specified in this Section.
 - r. Test metering devices as specified in this Section.
3. Test values:
- a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Electrical and mechanical interlocks shall operate in accordance with the system design.
 - d. Barrier and shutter installation and operation shall be in accordance with the manufacturer's design.
 - e. Indicating devices shall operate in accordance with system design.
4. Test values - electrical:
- a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate insulation values less than the allowable minimum.
 - c. Insulation-resistance values of control wiring shall not be less than 2 megohms.
 - d. Evaluate each vacuum interrupter in accordance with the test equipment manufacturer's instructions.
 - e. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
 - f. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the vacuum bottle integrity test, the vacuum bottle is considered to have passed the test.
 - g. Micro-ohm or DC millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
 - 1) If the manufacturer's published data is not available, investigate values which deviate from those of similar connections by more than 50 percent of the lowest value.
 - h. Resistance values of blowout coils shall be in accordance with the manufacturer's published data.
 - i. Resistance values shall not deviate by more than 15 percent between identical fuses.
 - j. Contactor coil shall operate with minimal vibration and noise.

- k. Control power transformer test results shall be as specified in NETA ATS.
 - l. Starting transformer test results shall be as specified in NETA ATS.
 - m. Starting reactor test results shall be as specified in NETA ATS.
 - n. Motor protection parameters shall be as specified in the manufacturer's published data.
 - o. System function test results shall be in accordance with the manufacturer's published data and system design.
 - p. Heaters shall be operational.
 - q. Instrument transformer test results shall be as specified in this Section.
 - r. Metering device test results shall be as specified in this Section.
- U. Motor starters, low voltage:
- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate information with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify the unit is clean.
 - e. Inspect contactors:
 - 1) Verify mechanical operation.
 - 2) Verify contact gap, wipe, alignment, and pressure is in accordance with the manufacturer's published data.
 - f. Motor-running protection:
 - 1) Verify overload element rating/motor protection settings are correct for its application.
 - 2) If motor running protection is provided by fuses, verify correct fuse rating.
 - g. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - h. Lubrication requirements:
 - 1) Verify appropriate lubrication on moving current-carrying parts.
 - 2) Verify appropriate lubrication on moving and sliding surfaces.
 - 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with the starter closed, and across each open pole for 1 minute:
 - 1) Test voltage shall be in accordance with the manufacturer's published data.
 - 2) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:
 - 1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

- d. Test motor protection devices in accordance with the manufacturer's published data.
- e. Test circuit breakers as specified in this Section.
- f. Perform operational tests by initiating control devices.
- 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate values of insulation-resistance less than the allowable minimum.
 - d. Insulation-resistance values of control wiring shall not be less than 2 megohms.
 - e. Motor protection parameters shall be in accordance with the manufacturer's published data.
 - f. Circuit breaker test results shall be as specified in this Section.
 - g. Control devices shall perform in accordance with system design requirements.

V. Motor control centers, low voltage:

- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding and required clearances.
 - d. Verify the unit is clean and shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.
 - e. Verify that circuit breaker/fuse sizes and types correspond to the approved Submittals and the coordination study.
 - f. Verify that current and voltage transformer ratios correspond to those indicated on the Drawings.
 - g. Verify that wiring connections are tight and that wiring is secure to prevent damage during routine operation of moving parts.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - i. Verify operation and sequencing of interlocking systems:
 - 1) Attempt closure on locked-open devices.
 - 2) Attempt to open locked-closed devices.
 - 3) Make/attempt key-exchanges in all positions.

- j. Lubrication requirements:
 - 1) Verify appropriate lubrication on moving current-carrying parts.
 - 2) Verify appropriate lubrication on moving and sliding surfaces.
- k. Inspect insulators for evidence of physical damage or contaminated surfaces.
- l. Verify correct barrier and shutter installation and operation.
- m. Exercise active components.
- n. Inspect indicating devices for correct operation.
- o. Verify that filters are in place and/or vents are clear.
- p. Perform visual and mechanical inspection of instrument transformers as specified in this Section.
- q. Perform visual and mechanical inspection of surge arresters as specified in this Section.
- r. Inspect control power transformers:
 - 1) Inspect for physical damage, cracked insulation, broken leads, and tightness of connections, defective wiring, and overall general condition.
 - 2) Verify that primary and secondary fuse/circuit breaker ratings match the Submittal Drawings.
 - 3) Verify correction functioning of grounding contacts.
- s. Perform visual and mechanical inspection of motor control center components as specified in this Section.
- 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for 1 minute:
 - 1) Perform test in accordance with NETA ATS tables.
 - c. Perform a dielectric withstand test on each bus section, each phase-to-ground with phases not under test grounded, in accordance with the manufacturer's published data or NETA ATS tables. Apply the test voltage for 1 minute.
 - d. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:
 - 1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
 - e. Perform electrical tests on instrument transformers as specified in this Section.
 - f. Perform ground-resistance tests:
 - 1) Perform point-to-point tests to determine the resistance between the main grounding system and major electrical equipment frames, system neutral and derived neutral points.
 - g. Control power transformers:
 - 1) Perform insulation-resistance tests, winding-to-winding and winding-to-ground:
 - a) Test voltages shall be in accordance with NETA ATS tables or as specified by the manufacturer.

- 2) Perform secondary wiring integrity test:
 - a) Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source:
 - (1) Verify correct potential at all devices.
- 3) Verify correct secondary voltage by energizing primary winding with system voltage:
 - a) Measure secondary voltage with the secondary wiring disconnected.
- h. Verify operation of space heaters.
- i. Perform electrical tests of motor control center components as specified in this Section.
- 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation-resistance values for bus and control power transformers shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate insulation values less than the allowable minimum.
 - 3) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
 - d. Bus insulation shall withstand the over potential test voltage applied.
 - e. Insulation-resistance values of control wiring shall not be less than 2 megohms.
 - f. Instrument transformer test values shall be as specified in this Section.
 - g. Investigate grounding system point-to-point resistance values that exceed 0.5 ohm.
 - h. Meter accuracy shall be in accordance with the manufacturer's published data.
 - i. Control power transformers:
 - 1) Insulation-resistance values of control power transformers shall be in accordance with the manufacturer's published data:
 - a) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - b) Investigate insulation values less than the allowable minimum.
 - c) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
 - 2) Secondary wiring shall be as indicated on the Drawings and specified in the Specifications.
 - 3) Secondary voltage shall be as indicated on the Drawings.
 - j. Heaters shall be operational.
 - k. Test values for motor control center components shall be as specified in this Section.

W. Variable frequency drive systems:

1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify the unit is clean.
 - e. Ensure vent path openings are free from debris and that heat transfer surfaces are clean.
 - f. Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.
 - g. Motor running protection:
 - 1) Verify drive overcurrent setpoints are correct for their application.
 - 2) If drive is used to operate multiple motors, verify individual overload element ratings are correct for their application.
 - 3) Apply minimum and maximum speed setpoints. Verify setpoints are within limitations of the load coupled to the motor.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - i. Verify correct fuse sizing in accordance with the manufacturer's published data.
 - j. Perform visual and mechanical inspection of input circuit breaker as specified in this Section.
2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with low resistance ohmmeter.
 - b. Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.
 - c. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:
 - 1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
 - d. Test for the following parameters in accordance with relay calibration procedures specified in NETA ATS, or as recommended by the manufacturer:
 - 1) Input phase loss protection.
 - 2) Input overvoltage protection.
 - 3) Output phase rotation.
 - 4) Overtemperature protection.
 - 5) Direct current overvoltage protection.
 - 6) Overfrequency protection.
 - 7) Drive overload protection.
 - 8) Fault alarm outputs.
 - e. Harmonic distortion measurements for both voltage and current is within the specification limits at the installed site.

- f. Peak voltage at the motor terminations is less than 90 percent of the motor insulation dielectric withstand level.
 - g. Perform continuity tests on bonding conductors as specified in accordance with NETA ATS.
 - h. Perform start-up of drive in accordance with the manufacturer's published data. Calibrate drive to the system's minimum and maximum speed control signals.
 - i. Perform operational tests by initiating control devices:
 - 1) Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.
 - 2) Verify operation of drive from remote start/stop and speed control signals.
 - j. Perform electrical tests of input circuit breaker as specified in this Section.
 - k. Measure fuse resistance.
3. Test values:
- a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Overload test trip times at 300 percent of overload element rating shall be in accordance with the manufacturer's published time-current curve.
 - d. Test values for input circuit breaker shall be as specified in this Section.
 - e. Insulation-resistance values of control wiring shall not be less than 2 megohms.
 - f. Relay calibration results shall be as specified in this Section.
 - g. Continuity of bonding conductors shall be in accordance with NETA ATS.
 - h. Control devices shall perform in accordance with system requirements.
 - i. Operational tests shall conform to system design requirements.
 - j. Investigate fuse resistance values that deviate from each other by more than 15 percent.

X. Surge arresters, low-voltage:

- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify the arresters are clean.
 - e. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - f. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

- g. Verify that stroke counter is correctly mounted and electrically connected, if applicable.
 - h. Record stroke counter reading.
 - 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform an insulation-resistance test on each arrester, phase terminal-to-ground:
 - 1) Apply voltage in accordance with manufacturer's published data.
 - 2) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Test grounding connection as specified in this Section.
 - 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate insulation values less than the allowable minimum.
 - d. Resistance between the arrester ground terminal and the ground system shall be less than 0.5 ohm.
- Y. Surge arresters, medium and high voltage:
 - 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify the arresters are clean.
 - e. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - f. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.
 - g. Verify that stroke counter is correctly mounted and electrically connected, if applicable.
 - h. Record stroke counter reading.
 - 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

- b. Perform an insulation-resistance test on each arrester, phase terminal-to-ground:
 - 1) Apply voltage in accordance with manufacturer's published data.
 - 2) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Test grounding connection as specified in this Section.
 - d. Perform a watts-loss test.
 - 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate insulation values less than the allowable minimum.
 - d. Resistance between the arrester ground terminal and the ground system shall be less than 0.5 ohm.
 - Z. Outdoor bus structures:
 - 1. Visual and mechanical inspection:
 - a. Compare bus arrangement with that indicated on the Drawings and specified in the Specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify the support insulators are clean.
 - e. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Measure insulation-resistance of each bus, phase- to- ground with other phases grounded:
 - 1) Apply voltage in accordance with the manufacturer's published data.
 - 2) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Perform dielectric withstand voltage test on each bus phase, phase-to-ground with other phases grounded. Potential application shall be for 1 minute.

3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - d. If no evidence of distress or insulation failure is observed at the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

AA. Uninterruptible power systems:

1. Testing and settings shall be conducted by the UPS manufacturer's field engineer. Test the complete operation of:
 - a. Static transfer system.
 - b. Static bypass system.
 - c. Maintenance bypass system.
2. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify that fuse sizes and types correspond to that indicated on the Drawings.
 - e. Verify the unit is clean.
 - f. Test electrical and mechanical interlock systems for correct operation and sequencing.
 - g. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - h. Verify operation of forced ventilation.
 - i. Verify that filters are in place and/or vents are clear.
3. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Test static transfer from inverter to bypass and back. Use normal load, if possible.
 - c. Set free running frequency of oscillator.
 - d. Test DC undervoltage trip level on inverter input breaker. Set according to manufacturer's published data.
 - e. Test alarm circuits.
 - f. Verify synchronizing indicators for static switch and bypass switches.

- g. Perform electrical tests for:
 - 1) UPS system breakers as specified in this Section.
 - 2) UPS system automatic transfer switches as specified in this Section.
 - 3) UPS system batteries as specified in this Section.
 - 4) UPS rotating machinery as specified in this Section.
- 4. Test values:
 - a. Electrical and mechanical interlock systems shall operate in accordance with system design requirements.
 - b. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - c. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - d. Static transfer shall function in accordance with the manufacturer's published data.
 - e. Oscillator free running frequency shall be within the manufacturer's published tolerances.
 - f. Direct current undervoltage shall trip inverter input breaker.
 - g. Alarm circuits shall operate in accordance with design requirements.
 - h. Synchronizing indicators shall operate in accordance with design requirements.
 - i. Breaker performance shall be as specified in this Section.
 - j. Automatic transfer switch performance shall be as specified in this Section.
 - k. Battery test results shall be as specified in this Section.
 - l. Rotating machinery performance shall be as specified in this Section.

BB. Automatic transfer switches:

- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify the unit is clean.
 - e. Lubrication requirements:
 - 1) Verify appropriate lubrication on moving current-carrying parts.
 - 2) Verify appropriate lubrication on moving and sliding surfaces.
 - f. Verify that manual transfer warnings are attached and visible.
 - g. Verify tightness of control connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - i. Perform manual transfer operation.
 - j. Verify positive mechanical interlocking between normal and alternate sources.

2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform a contact/pole-resistance test.
 - c. Verify settings and operation of control devices.
 - d. Calibrate and set relays and timers as specified in this Section.
 - e. Verify phase rotation, phasing, and synchronized operation as required by the application.
 - f. Perform automatic transfer tests:
 - 1) Simulate loss of normal power.
 - 2) Return to normal power.
 - 3) Simulate loss of emergency power.
 - 4) Simulate all forms of single-phase conditions.
 - g. Verify correct operation and timing of the following functions:
 - 1) Normal source voltage-sensing and frequency-sensing relays.
 - 2) Engine start sequence.
 - 3) Time delay upon transfer.
 - 4) Alternate source voltage-sensing and frequency-sensing relays.
 - 5) Automatic transfer operation.
 - 6) Interlocks and limit switch function.
 - 7) Time delay and retransfer upon normal power restoration.
 - 8) Engine cool down and shutdown feature.
3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - c. Insulation resistance values of transfer switches shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Values of insulation resistance less than this table or the manufacturer's recommendations shall be investigated.
 - d. Insulation-resistance values of control wiring shall not be less than 2 megohms.
 - e. Micro-ohm or DC millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
 - 1) If the manufacturer's published data is not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - f. Control devices shall operate in accordance with the manufacturer's published data.
 - g. Relay test results shall be as specified in this Section.
 - h. Phase rotation, phasing, and synchronization shall be as specified in the system design specifications.
 - i. Operation and timing shall be in accordance with the manufacturer's and system design requirements.

CC. Switches, air, low-voltage:

1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify the unit is clean.
 - e. Verify correct blade alignment, blade penetration, travel stops, and mechanical operation.
 - f. Verify that fuse sizes and types as indicated on the Drawings, short-circuit studies, and coordination study.
 - g. Verify that each fuse has adequate mechanical support and contact integrity.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of a low resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - i. Verify operation and sequencing of interlocking systems.
 - j. Verify correct phase barrier installation.
 - k. Verify correct operation of indicating and control devices.
 - l. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Measure contact resistance across each switchblade and fuse holder.
 - c. Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, use NETA ATS requirements.
 - d. Measure fuse resistance.
 - e. Verify cubicle space heater operation.
 - f. Perform ground fault test as specified in this Section, if applicable.
 - g. Perform tests on other protective devices as specified in this Section, if applicable.
3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connection by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.

4. Test values - electrical:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Micro-ohm or DC millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
 - 1) If the manufacturer's published data is not available, investigate values which deviate from those of similar bus connections and sections by more than 50 percent of the lowest value.
 - c. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate insulation values less than the allowable minimum.
 - d. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Heaters shall be operational.
 - f. Ground fault tests shall be as specified in this Section.
 - g. Results of protective device tests shall be as specified in this Section.

DD. Switches, air, medium-voltage, metal-enclosed:

1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and required clearances.
 - d. Verify the unit is clean.
 - e. Verify correct blade alignment, blade penetration, travel stops, arc interrupter operation, and mechanical operation.
 - f. Verify that fuse sizes and types are as indicated on the Drawings, short-circuit study, and coordination study.
 - g. Verify that expulsion-limiting devices are in place on holders having expulsion-type elements.
 - h. Verify that each fuse holder has adequate mechanical support and contact integrity.
 - i. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of a low resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - j. Verify operation and sequencing of interlocking systems.
 - k. Verify correct phase barrier installation.
 - l. Verify correct operation of indicating and control devices.
 - m. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Measure contact resistance across each switchblade and fuse holder.

- c. Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, use NETA ATS requirements.
- d. Perform a dielectric withstand voltage test on each pole with switch closed. Test each pole-to-ground with all other poles grounded. Test voltage shall be in accordance with the manufacturer's published data:
 - 1) In the absence of the manufacturer's published data, use NETA ATS requirements.
- e. Measure fuse resistance.
- f. Verify cubicle space heater operation.
- 3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
- 4. Test values - electrical:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Micro-ohm or DC millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data.
 - 1) If the manufacturer's published data is not available, investigate values which deviate from those of similar bus connections and sections by more than 50 percent of the lowest value.
 - c. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Investigate insulation values less than the allowable minimum.
 - 3) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
 - d. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
 - e. Investigate fuse resistance values that deviate from each other by more than 15 percent.
 - f. Heaters shall be operational.

EE. Fiber-optic cables:

- 1. Visual and mechanical inspection:
 - a. Compare cable, connector, and splice data with the Contract Documents.
 - b. Inspect cable and connections for physical and mechanical damage.
 - c. Verify that connectors and splices are correctly installed.

2. Optical tests:
 - a. Perform cable length measurement, fiber fracture inspection, and construction defect inspection using an optical time domain reflectometer (OTDR):
 - 1) OTDR test performed on fiber cables less than 100 meters shall be performed with the aid of a launch cable.
 - 2) Adjust OTDR pulse width settings to a maximum setting of 1/1,000th of the cable length or 10 nanoseconds.
 - b. Perform connector and splice integrity test using an optical time domain reflectometer.
 - c. Perform cable attenuation loss measurement with an optical power loss test set:
 - 1) Perform attenuation tests with an optical loss test set capable and calibrated to show anomalies of 0.1 dB as a minimum.
 - 2) Test multimode fibers at 850 nanometer and 1,300 nanometer.
 - 3) Test single mode fibers at 1,310 nanometer and 1,550 nanometer.
 - d. Perform connector and splice attenuation loss measurement from both ends of the optical cable with an optical power loss test set:
 - 1) At the conclusion of all outdoor splices at 1 location, and before they are enclosed and sealed, splices shall be tested with OTDR at the optimal wavelengths (850 and 1,300 for multimode, 1,310 and 1,550 for single mode), in both directions. Splices shall be tested for integrity as well as attenuation.
 - e. Perform fiber links integrity and attenuation tests using each link shall be an OTDR and an optical loss test set:
 - 1) OTDR traces shall be from both directions on each fiber at the 2 optimal wavelengths, 850 nanometer, and 1,300 nanometer for multimode fibers.
 - 2) Optical loss testing shall be done with handheld test sets in 1 direction at the 2 optimal wavelengths for the appropriate fiber type. Test equipment shall equal or exceed the accuracy and resolution of Agilent/HP 8147 high performance OTDR.
3. Test values:
 - a. Cable and connections shall not have been subjected to physical or mechanical damage.
 - b. Connectors and splices shall be installed in accordance with industry standards.
 - c. Optical time domain reflectometer signal should be analyzed for excessive connection, splice, or cable backscatter by viewing the reflected power/distance graph.
 - d. Attenuation loss measurement shall be expressed in dB/km. Losses shall be within the manufacturer's recommendations when no local site specifications are available.
 - e. Individual fusion splice losses shall not exceed 0.1 dB. Measurement results shall be recorded, validated by trace, and filed with the records of the respective cable runs.

FF. Copper Ethernet cable installation testing:

1. Pre-installation:
 - a. Immediately prior to installation, verify that cable to be installed matches that which was submitted.

- b. Verify that no damage has been done to the cable during shipping or handling.
- c. Inspect cable for physical and mechanical damage.
- d. Engineer shall be notified if a cable fails to meet inspection and the cable shall not be installed unless otherwise directed by the Engineer.
- 2. Post-installation:
 - a. Prior to copper Ethernet cable termination, perform cable end-to-end continuity validation testing on installed cables, conductor pairs and cable shields using toner and probe kit. Any cable that fails testing shall be removed and replaced.
 - b. Inspect equipment outlet connectors for damage and ensure connectors hold tightly in field device ports.
- 3. Test equipment:
 - a. Certification equipment used for the testing shall be capable of verifying twisted pair cable installation with end-to-end continuity testing.
 - b. Use only test cords and adapters that are qualified by the test equipment manufacturer for channel or link test configuration.
 - c. Manufacturers: The following or equal:
 - 1) Fluke Networks, IntelliTone Pro 200 Toner and Probe Kit, MT-8200-60-KIT.
 - d. Permanent link testing requirements: As specified in Section 40_80_01 - Commissioning for Instrumentation and Controls.

GG. Capacitors and reactors, capacitors:

- 1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify the unit is clean.
 - e. Verify that capacitors are electrically connected in their specified configuration.
 - f. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels NETA ATS tables.
- 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests from phase terminal(s) to case for 1 minute.
 - 1) Apply voltage in accordance with the manufacturer's published data. In the absence of the manufacturer's published data, refer to NETA ATS tables.
 - c. Measure the capacitance of terminal combinations.
 - d. Measure resistance of the internal discharge resistors.

3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's data.
4. Test values - electrical:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Insulation-resistance values shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 - 2) Values of insulation-resistance less than NETA ATS tables or the manufacturer's recommendations should be investigated.
 - c. Investigate capacitance values differing from the manufacturer's published data.
 - d. Investigate discharge resistor values differing from the manufacturer's published data. In accordance with NFPA 70 NEC, Article 460, residual voltage of a capacitor shall be reduced to 50 volts in the following time intervals after being disconnected from the source of supply:

Rated Voltage	Discharge Time
Less than or equal to 600 volts	1 minute
Greater than 600 volts	5 minutes

HH. Direct-current systems, batteries, flooded lead-acid:

1. Visual and mechanical inspection:
 - a. Verify that battery area ventilation system is operable.
 - b. Verify existence of suitable eyewash equipment.
 - c. Compare equipment nameplate data with the Contract Documents.
 - d. Inspect physical and mechanical condition.
 - e. Verify adequacy of battery support racks, mounting, anchorage, alignment, grounding, and clearances.
 - f. Verify electrolyte level. Measure electrolyte specific gravity and temperature levels.
 - g. Verify presence of flame arresters.
 - h. Verify the units are clean.
 - i. Inspect spill containment installation.
 - j. Verify application of an oxide inhibitor on battery terminal connections.
 - k. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low resistance ohmmeter.

- 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels NETA ATS tables.
 2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Measure charger float and equalizing voltage levels. Adjust to the battery manufacturer's recommended settings.
 - c. Verify charger functions and alarms.
 - d. Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.
 - e. Measure intercell connection resistances.
 - f. Perform internal ohmic measurement tests.
 - g. Perform a load test in accordance with the manufacturer's published data or IEEE 450.
 - h. Measure the battery system voltage from positive to ground and negative to ground.
 3. Test values:
 - a. Electrolyte level and specific gravity shall be within normal limits.
 - b. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - c. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
 4. Test values - electrical:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Charger float and equalize voltage levels shall be in accordance with the battery manufacturer's published data.
 - c. Results of charger functions and alarms shall be in accordance with the manufacturer's published data.
 - d. Cell voltages shall be within 0.05 volt of each other or in accordance with the manufacturer's published data.
 - e. Cell internal ohmic values (resistance, impedance, or conductance) shall not vary by more than 25 percent between identical cells in a fully charged state.
 - f. Results of load tests shall be in accordance with the manufacturer's published data or IEEE 450.
 - g. Voltage measured from positive to ground shall be equal in magnitude to the voltage measured from negative to ground.
- II. Direct-current systems, batteries, vented nickel-cadmium:
 1. Visual and mechanical inspection:
 - a. Verify that batteries are adequately located.
 - b. Verify that battery area ventilation system is operable.

- c. Verify existence of suitable eyewash equipment.
 - d. Compare equipment nameplate data with the Contract Documents.
 - e. Inspect physical and mechanical condition.
 - f. Verify adequacy of battery support racks or cabinets, mounting, battery spill containment system, anchorage, alignment, grounding, and clearances.
 - g. Verify electrolyte level. Measure pilot-cell electrolyte temperature.
 - h. Verify the units are clean.
 - i. Verify application of an oxide inhibitor on battery terminal connections.
 - j. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of a low resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
2. Electrical tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Measure charger float and equalizing voltage levels. Adjust to the battery manufacturer's recommended settings.
 - c. Verify charger functions and alarms.
 - d. Measure each cell voltage and total battery voltage with charger energized and in float mode of operation.
 - e. Measure intercell connection resistances.
 - f. Perform internal ohmic measurement tests.
 - g. Perform a load test in accordance with the manufacturer's published data or IEEE 1106.
 - h. Measure the battery system voltage from positive to ground and negative to ground.
3. Test values:
- a. Electrolyte level shall be within normal limits.
 - b. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - c. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
4. Test values - electrical:
- a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Charger float and equalize voltage levels shall be in accordance with the battery manufacturer's published data.
 - c. Results of charger functions and alarms shall be in accordance with the manufacturer's published data.
 - d. Cell voltages shall be within 0.05 volt of each other or in accordance with the manufacturer's published data.

- e. Cell internal ohmic values (resistance, impedance, or conductance) shall not vary by more than 25 percent between identical cells that are in a fully charged state, or shall be in accordance with the manufacturer's published data.
- f. Results of load tests shall be in accordance with the manufacturer's published data.
- g. Voltage measured from positive to ground shall be equal in magnitude to the voltage measured from negative to ground.

JJ. Direct-current systems, batteries, valve-regulated lead-acid:

1. Visual and mechanical inspection:
 - a. Verify that batteries are adequately located.
 - b. Verify that battery area ventilation system is operable.
 - c. Verify existence of suitable eyewash equipment.
 - d. Compare equipment nameplate data with the Contract Documents.
 - e. Verify adequacy of battery support racks or cabinets, mounting, anchorage, alignment, grounding, and clearances.
 - f. Verify the units are clean.
 - g. Verify the application of an oxide inhibitor on battery terminal connections.
 - h. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Measure negative post temperature.
 - c. Measure charger float and equalizing voltage levels.
 - d. Verify charger functions and alarms.
 - e. Measure each monoblock/cell voltage and total battery voltage with charger energized and in float mode of operation.
 - f. Measure intercell connection resistances.
 - g. Perform internal ohmic measurement tests.
 - h. Perform a load test in accordance with the manufacturer's published data or IEEE 1188.
 - i. Measure the battery system voltage from positive to ground and negative to ground.
3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.

4. Test values - electrical:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Negative post temperature shall be within the manufacturer's published data or IEEE 1188.
 - c. Charger float and equalize voltage levels shall be in accordance with the battery manufacturer's published data.
 - d. Results of charger functions and alarms shall be in accordance with the manufacturer's published data.
 - e. Monoblock/cell voltages shall be in accordance with the manufacturer's published data.
 - f. Monoblock/cell internal ohmic values (resistance, impedance, or conductance) shall not vary by more than 25 percent between identical monoblocks/cells in a fully charged state.
 - g. Results of load tests shall be in accordance with the manufacturer's published data or IEEE 1188.
 - h. Voltage measured from positive to ground shall be similar in magnitude to the voltage measured from negative to ground.

KK. Direct-current systems, chargers:

1. Visual and mechanical inspection:
 - a. Compare equipment nameplate data with the Contract Documents.
 - b. Inspect for physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify the unit is clean.
 - e. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
 - a) Refer to the manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
 - f. Inspect filter and tank capacitors.
 - g. Verify operation of cooling fans and presence of filters.
2. Electrical tests:
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Verify float voltage, equalize voltage, and high voltage shutdown settings.
 - c. Verify current limit.
 - d. Verify correct load sharing (parallel chargers).
 - e. Verify calibration of meters as specified in this Section.
 - f. Verify operation of alarms.
 - g. Measure and record input and output voltage and current.
 - h. Measure and record AC ripple current and voltage imposed on the battery.
 - i. Perform full-load testing of charger.

3. Test values:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with the manufacturer's published data:
 - 1) Refer to NETA ATS tables in the absence of the manufacturer's published data.
4. Test values - electrical:
 - a. Compare bolted connection resistance values to values of similar connections:
 - 1) Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Float and equalize voltage settings shall be in accordance with the battery manufacturer's published data.
 - c. Current limit shall be within the manufacturer's recommended maximum.
 - d. Results of load sharing between parallel chargers shall be in accordance with system design specifications.
 - e. Results of meter calibration shall be as specified in this Section.
 - f. Results of alarm operation shall be in accordance with the manufacturer's published data and system design.
 - g. Input and output voltage shall be in accordance with the manufacturer's published data.
 - h. AC ripple current and voltage imposed on the battery shall be in accordance with the manufacturer's published data.
 - i. Charger shall be capable of the manufacturer's specified full load.

3.05 FIELD QUALITY CONTROL (NOT USED)

3.06 ADJUSTING (NOT USED)

3.07 CLEANING

- A. Dispose of testing expendables.
- B. Vacuum cabinets.
- C. Sweep clean surrounding areas.

END OF SECTION

SECTION 26_09_13
ELECTRICAL POWER MONITORING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Power meters and accessories.

1.02 REFERENCES

- A. American National Standard Institute (ANSI):
 - 1. C12.20 - Electricity Meters - 0.2 and 0.5 Accuracy Classes.
- B. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. C57.13.6 - Standard for High Accuracy Instrument Transformers.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. FS - Full scale.
 - 2. SSM - Solid state multifunction power meter.
 - 3. THD - Total harmonic distortion.

1.04 DELEGATED DESIGN (NOT USED)

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Power meter data, including, but not limited to:
 - a. Power requirements.
 - b. Communications protocols.
 - c. Input/outputs.
 - d. Dimensions.
 - e. Measurement functions.
 - f. Front panel controls.
 - g. Display characteristics.
 - 2. Accessory data:
 - a. Test switch dimensions and wiring diagrams.
- C. Owner Training Submittals:
 - 1. As specified in Section 01_75_17 - Commissioning.

- D. Operation and maintenance manuals:
 - 1. As specified in Section 01_78_24 - Operation and Maintenance Manuals.
 - 2. Descriptive and technical bulletins and sales aids edited to reflect only the equipment to be provided and covering each of the components in the system.
 - 3. A maintenance section including instruction leaflets and technical data necessary to setup, change setup and maintain the power meters.
 - 4. Original licensed copies of software and software manuals.
- E. Configuration files and reports:
 - 1. Settings, including, but not limited to:
 - a. Device tag name.
 - b. IP addresses.
 - c. Alarm settings.
 - d. Time synchronization settings.
 - e. Security settings.
 - 2. Configuration files are to be provided in the selected manufacturer's native format.
 - 3. Configuration reports are to be submitted in .PDF format, listing each configured parameter setting and description of each parameter.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.09 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.10 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA (NOT USED)

2.03 MANUFACTURERS

- A. One of the following or equal:
 - 1. ABB.
 - 2. Allen-Bradley.
 - 3. Eaton.
 - 4. Electro Industries/GaugeTech Power Meters.
 - 5. GE Multilin.
 - 6. Schneider Electric.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS

A. Power meters:

1. Power meter type 1 (SSM1) device shall be used in MCCs and shall include at a minimum:
 - a. Individual phase currents, within 0.5 percent FS.
 - b. Phase-to-phase and phase-to-neutral voltages, within 0.5 percent FS.
 - c. Watts, VARs, VA, within 1 percent FS.
 - d. Watt-hours, VAR-hours, VA-hours, within 1 percent FS.
 - e. PF (apparent and displacement), within 2 percent FS.
 - f. Frequency, within 1 percent hertz.
 - g. Demand:
 - 1) Ampere, within 0.5 percent FS.
 - 2) Watt, VAR, VA, within 1 percent FS.
 - h. Minimum and maximum values:
 - 1) Volts (L-L), volts (L-N), current, watts, VARs, VA.
 - 2) Power factor:
 - a) Apparent.
 - b) Displacement.
 - c) Frequency.
 - i. Synch-input kilowatts utility.
 - j. LCD with LED backlight.
 - k. Communications:
 - 1) EtherNet/IP.
2. Power meter analyzer (SSM2) device shall be used in SWBD and shall include at a minimum:
 - a. Individual phase currents, within 0.2 percent FS.
 - b. Phase-to-phase and phase-to-neutral voltages, within 0.2 percent FS.
 - c. Watts, VARs, VA, within 0.4 percent FS.
 - d. Watt-hours 0.5 percent OR; VAR-hours 1 percent OR; VA-hours 0.5 percent OR.
 - e. PF apparent 0.8 percent FS; PF displacement 0.8 percent FS.
 - f. Frequency, 0.04 percent, or 0.01 hertz.
 - g. THD:
 - 1) Voltage - 50th harmonic.
 - 2) Current - 50th harmonic.
 - h. Demand:
 - 1) Ampere, within 0.2 percent FS.
 - 2) Watt, VAR, VA, within 0.4 percent FS.
 - i. Revenue accuracy in accordance with ANSI C12.20 0.2 class.
 - j. Minimum and maximum values:
 - 1) Volts (L-L), volts (L-N), current (L, N, G), watts, VARs, VA.
 - 2) PF (apparent and displacement).
 - 3) Frequency.
 - 4) THD-amps, THD-volts.

- 5) Demand:
 - a) Ampere, watt, VAR, VA.
- k. Trend analysis:
 - 1) Time/date.
- l. Event logging:
 - 1) 504 events with time stamp.
- m. Disturbance recording:
 - 1) 10 waveform events.
- n. Inputs/outputs:
 - 1) 4 Form C relays, rated 10 amps.
 - 2) Four 0 to 10/4 to 20 milliamperes analog outputs.
 - 3) 3 plus 30 VDC differential discrete inputs.
 - 4) One 0 to 20/4 to 20 milliamperes analog input.
- o. Kilowatt hour pulse initiator.
- p. Waveform display - local/computer.
- q. Frequency distribution display - local/computer.
- r. Synch-Input kilowatt utility.
- s. Graphic LCD with LED backlight.
- t. Communications:
 - 1) EtherNet/IP.

2.08 ACCESSORIES

- A. Current transformers:
 - 1. Ring type:
 - a. Suitable for service within low or medium voltage equipment as indicated on the Drawings.
 - b. Designed to have a mechanical and thermal rating to withstand short-circuit current, stresses, and heating effects equal to the rating of the equipment of the application.
 - 2. Current ratio: As indicated on the Drawings.
 - 3. Rated in accordance with IEEE C57.13.6 with accuracy of the current transformers suitable for relay accuracy class and rated for 200 percent burden for the required connected devices.
 - 4. Identify polarity with standard marking or symbols.
 - 5. Capable of carrying rated primary current continuously without damage.
 - 6. Install secondary wiring from current transformers in a suitable wiring trough, or conduit to proper short-circuiting type terminal blocks for connection to relays, instruments, and other devices.
 - 7. 3 CTs for 3-wire systems. 4CTs for 4-wire systems.
- B. Test switches:
 - 1. Ten-pole:
 - a. 3 voltage poles, for phase voltage:
 - 1) 600 V rated.
 - b. Four 30 A, non-shorting current poles, for neutral current and let-thru phase currents.
 - c. Three 30 A, shorting current poles, for shorting phase currents.
 - 2. Base to be made of electrical grade plastic.
 - 3. Barriers between poles for pole isolation and separation.

4. Clear cover encapsulating the test switch to enable visual verification of each switch position.
5. Knife-blade type switches, accepting a horizontal gang interlocking bar.
6. Screw type terminals on each switch.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. Install power meters in accordance with the manufacturer's instructions in the electrical equipment as indicated on the Drawings.

3.04 FIELD QUALITY CONTROL

- A. Field electrical acceptance testing:
 1. As specified in Section 26_08_50 - Field Electrical Acceptance Tests.

3.05 OWNER TRAINING

- A. Perform Owner Training as specified in Section 01_75_17 - Commissioning.
 1. Number of sessions:
 - a. Operations and Maintenance: 1.

END OF SECTION

SECTION 26_23_01

SERVICE ENTRANCE AUTOMATIC TRANSFER EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Low voltage equipment automatic transfer system.

1.02 REFERENCES

- A. Underwriters Laboratories, Inc. (UL).

1.03 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Anchoring and bracing.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Include the following for the low voltage equipment:
 - a. Description of the automatic transfer system.
 - b. Catalog data for automatic transfer system components.
 - c. Product data describing the controller.
 - 2. Submit operator interface displays in full color as they will appear on the display screen:
 - a. Uniquely title each display.
 - b. Provide alarm and graphic displays.
 - c. At a minimum, the Submittal shall include the following screens:
 - 1) Provide a 1-line screen of controllable breakers, their states, and a color-coded representation of which bus(es) are energized.
 - 2) Provide a timer screen showing selected value, default, and allowable range for each adjustable timer:
 - a) Match timer designations to those specified in the automatic transfer system operation description.
 - 3) Provide an input/output screen showing discrete and analog hardwired input/output points, with each point's current state:
 - a) Indicate current state in color-coded form:
 - (1) Discrete points: Active/not active.
 - (2) Analog point: In engineering units.

- C. Shop Drawings:
 - 1. Include the following in the Shop Drawing Submittal for the low voltage equipment:
 - a. Complete interface and connection diagrams to the engine control panel.
 - b. Schematic and interconnection diagrams for the controller.
- D. Delegated Design Submittals:
 - 1. Anchoring and bracing: Provide project-specific calculations based on support conditions and requirements to resist loads specified in Section 01_81_50 - Design Criteria:
 - a. To structures for equipment installed in structures designated as seismic design category C, D, E, or F.
 - b. For equipment installed outdoors.
- E. Installation instructions:
 - 1. Written instructions must detail the complete installation of the equipment, including rigging, moving, and setting into place.
 - 2. Provide manufacturer's installation instructions.
- F. Quality Control Submittals:
 - 1. Manufacturer's representative qualifications.
 - 2. Manufacturer's Certificate of Source Testing as specified in Section 01_75_17 - Commissioning.
 - 3. Manufacturer's Certificate of Installation Verification as specified in Section 01_75_17 - Commissioning.
 - 4. Test reports.
- G. Owner Training Submittals:
 - 1. As specified in Section 01_75_17 - Commissioning.
- H. Utility coordination:
 - 1. Submit certifications as specified in Section 26_05_03 - Utility Coordination.
 - 2. Submit table of utility required parameters and settings for protective relays and control functions.
- I. Operation and maintenance manuals:
 - 1. As specified in Section 01_78_24 - Operation and Maintenance Manuals.
 - 2. Include the following in the operation manuals Submittal for the low voltage automatic transfer equipment:
 - a. Description of the sequence of operation that outlines the steps the controls follow during normal power failure and normal power return conditions.
 - b. Detail the operational function of controls and internal controller programming.
 - c. Report listing the installed setting of all adjustable parameters for automatic transfer system.

1.05 QUALITY ASSURANCE

- A. Automatic transfer system and components shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. As specified in Section 26_24_14 - Group-Mounted Circuit Breaker Switchboards.

1.07 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing:
 - 1. As specified in Section 26_24_14 - Group-Mounted Circuit Breaker Switchboards .

1.09 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

1.10 SYSTEM START-UP

- A. As specified in Section 26_24_14 - Group-Mounted Circuit Breaker Switchboards.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Provide equipment and components that are fully rated for the Site elevation and operating environment where the equipment will be installed as specified in Section 01_81_50 - Design Criteria and as indicated on the Drawings.
- B. Non-conditioned spaces:
 - 1. Provide additional temperature conditioning equipment to maintain the equipment temperature within a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature.
- C. Outdoor installations:
 - 1. Provide conditioning equipment incorporated into the equipment to maintain the enclosures within the equipment manufacturer's specified operating ranges.
- D. Provide an automatic transfer system as an integral part of the low voltage equipment:
 - 1. Requirements of Section 26_24_14 - Group-Mounted Circuit Breaker Switchboards apply.

- E. Automatic transfer system operation:
1. Transfer and re-transfer schemes:
 - a. Automatic mode:
 - 1) When the normal source voltage fails or if a single-phase condition occurs, the control system shall:
 - a) Initiate normal source failure (adjustable) timer.
 - b) Upon completion of the normal source failure timer:
 - (1) Open the commercial source breaker.
 - (2) Signal the engine to start via the engine control panel.
 - 2) When the generator has reached normal operating voltage and frequency for an adjustable period of time, the control system shall:
 - a) Verify the normal source breaker is open.
 - b) Close the standby source breaker.
 - 3) When the control system detects the return of normal source voltage for an adjustable period of time, the control system shall:
 - a) Open the standby source breaker.
 - b) Initiate a neutral position timer.
 - c) Upon completion of the timer, close the normal source breaker.
 - d) After the control system has opened the engine source breaker, the control system will continue to run the engine generator for an adjustable cool down period of time.
 - b. Test mode (automatic mode only):
 - 1) Provide a selector switch to test the automatic transfer system, including starting of the engine-generator:
 - a) Moving the selector switch to the test position will have the same effect as a normal power loss. Control system shall:
 - (1) Initiate normal failure timer.
 - (2) Open normal source breaker:
 - (a) Signal engine generator to start.
 - (b) Verify normal source breaker open.
 - (c) Close stand-by source breaker.
 - b) Return to normal will have the same effect as restoration of the normal power. Control system shall:
 - (1) Open the stand-by source breaker.
 - (2) Initiate a neutral position timer.
 - (3) Upon completion of the timer, close the normal source breaker.
 - (4) After the control system has opened the engine source breaker, the control system will continue to run the engine generator for an adjustable cool down period of time.
 - c. Manual transfer operating mode:
 - 1) Moving the transfer operation switch to manual will disengage the automatic transfer capability.
 - 2) Manual transfer to stand-by power:
 - a) Open the normal source breaker via pushbutton on automatic transfer equipment.
 - b) Start engine generator via engine control panel.
 - c) Close stand-by source breaker via selector switch on automatic transfer equipment.
 - 3) Standby source breaker will not be allowed to close until engine generator has reached normal operating voltage and frequency.

- 4) Manual transfer to normal source:
 - a) Open the engine source breaker via pushbutton on automatic transfer equipment.
 - b) Close normal source breaker via selector switch on automatic transfer equipment.
 - c) Stop engine generator via engine control panel after a cool down period of time.
2. If the normal source breaker has tripped due to any fault condition, the control system shall not signal the engine to start or initiate a transfer to the standby source, until the fault has been removed.

2.03 MANUFACTURERS

- A. The following or equal:
 1. Relays:
 - a. Negative sequence and under/overvoltage relay:
 - 1) Basler Electric.
 - b. Under/overvoltage relay:
 - 1) Basler Electric.
 - c. Under/over frequency relay:
 - 1) Basler Electric.
 - d. Battery under voltage relay:
 - 1) Basler Electric.
 2. Selector switches:
 - a. ABB:
 - 1) Type SB.
 3. Pushbuttons and pilot lights:
 - a. General:
 - 1) Provide operator pushbuttons, switches, and pilot lights from a single manufacturer.
 - 2) Size:
 - a) 30.5 millimeters.
 - 3) Heavy duty.
 - 4) Pushbuttons:
 - a) Contacts rated:
 - (1) NEMA Type A600.
 - b) Furnish 1 spare normally open contact and normally closed contact with each switch.
 - c) Equipment shutdown (ESD): Palm or mushroom-head type with self-latching feature. ESD device will remain in the actuated position until deliberately reset.
 - 5) Selector switches:
 - a) Contacts rated:
 - (1) NEMA Type A600.
 - (2) Knob type.
 - b) Furnish 1 spare normally open contact and normally closed contact with each switch.
 - c) Provisions for locking in the OFF position where lockout provisions are indicated on the Drawings.

- 6) Pilot lights:
 - a) Type:
 - (1) LED for interior installations.
 - b) Push to test.
 - c) Lamp color:
 - (1) On/Running/Start: Red.
 - (2) Off/Stop: Green.
 - (3) Power: White.
 - (4) Alarm: Amber.
 - (5) Status or normal condition: White.
 - (6) Opened: Red.
 - (7) Closed: Green.
 - (8) Failure: Red.
- b. Indoor and outdoor areas:
 - 1) NEMA Type 4/13.
 - 2) Manufacturers: One of the following or equal:
 - a) Allen-Bradley, Type 800T.
 - b) General Electric, Type CR104P.
 - c) IDEC, TWND Series.
 - d) Schneider Electric, Class 9001, Type K.
- 4. Control system:
 - a. As recommended by the equipment manufacturer.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

- A. As specified in Section 26_24_14 - Group-Mounted Circuit Breaker Switchboards.
- B. Automatic equipment transfer system configuration:
 - 1. Utilizes circuit breakers as the transfer mechanisms.
 - 2. Provide equipment for operation, including, but not limited to:
 - a. Interface circuits.
 - b. Relays.
 - c. Interlocks.
 - d. Control fuses.
 - e. Fuse blocks.
 - 3. Provide controls on the front door of the automatic transfer system equipment section as indicated on the Drawings.
 - 4. Provide DC power for pilot lights, protective relays, automatic transfer system control power, and shunt trip circuits from the substation battery system.

2.07 COMPONENTS

- A. Pilot lights:
 - 1. As specified in above.
- B. Negative sequence and over/under voltage relay:
 - 1. Connected to signal the automatic transfer control system to operate upon sensing abnormal conditions.
 - 2. Mechanical trip indicator and target reset:
 - a. 1 target for 47N Negative sequence device.
 - b. 1 target for 27/59 over/under voltage devices.
 - 3. Provide contacts for connection to monitoring system.
 - 4. Powered from the substation battery system.
 - 5. Provide the following functions:
 - a. 47N device-negative sequence:
 - 1) Adjustable definite time characteristic.
 - 2) Capable of sensing a single-phase condition.
 - 3) Relay shall be of the negative sequence design and not rely solely on voltage differences or imbalances.
 - b. Adjustable negative sequence level:
 - 1) 27 device-undervoltage relay.
 - 2) Adjustable definite time characteristic.
 - 3) Adjustable pick-up level.
 - c. 59 device-overvoltage relay:
 - 1) Adjustable definite time characteristic.
 - 2) Adjustable pick-up level.
- C. Over/under voltage device:
 - 1. Connected to signal the automatic transfer control system to operate upon sensing abnormal conditions from the engine generator.
 - 2. With mechanical trip indicator and target reset:
 - a. 1 target for 27 undervoltage device.
 - b. 1 target for 59 overvoltage device.
 - 3. Provide contacts for connection to monitoring system.
 - 4. Powered from the substation battery system.
 - 5. Provide the following functions:
 - a. 27 device-undervoltage relay:
 - 1) Adjustable definite time characteristic.
 - 2) Adjustable pick-up level.
 - b. 59 device-overvoltage relay:
 - 1) Adjustable definite time characteristic.
 - 2) Adjustable pick-up level.
- D. Over/under frequency device:
 - 1. Connected to signal the automatic transfer control system to operate upon sensing abnormal conditions for the engine generator.
 - 2. Mechanical trip indicator and target reset:
 - a. 1 target for 81O over frequency device.
 - b. 1 target for 81U under frequency device.
 - 3. Provide contacts for connection to monitoring system.
 - 4. Powered from the substation battery system.

5. Provide the following functions:
 - a. 81O device-over frequency:
 - 1) Adjustable definite time characteristic.
 - 2) Relay shall be of the over frequency design single phase sensing.
 - 3) Adjustable pick-up level.
 - b. 81U device-under frequency:
 - 1) Adjustable definite time characteristic.
 - 2) Single phase sensing.
 - 3) Adjustable pick-up level.

2.08 ACCESSORIES

- A. Circuit breakers:
 1. Normal and standby breaker electrical interlocks:
 - a. Prevent both breakers from being closed at the same time and prevent both breakers from closing at the same time (when either electrically or manually operated).
 - b. Prevent one breaker from trying to close while the other breaker is closed and shall prevent both breaker close coils (or motor operators) from operating at the same time:
 - 1) Interlock shall not prevent both breakers from being open at the same time.

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

- A. As specified in Section 26_24_14 - Group-Mounted Circuit Breaker Switchboards.
- B. Source Testing:
 1. Not witnessed.
 2. Test the complete automatic transfer equipment at the manufacturer's establishment.
 3. Furnish test reports and Manufacturer's Certificate of Source Testing.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

- A. Anchoring and bracing to structures:
 1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
 2. Install anchors of type and material indicated on approved anchoring designs.
 3. Install anchors with embedment indicated on approved anchoring designs.

3.03 INSTALLATION

- A. As specified in Section 26_24_14 - Group-Mounted Circuit Breaker Switchboards .
- B. Furnish Manufacturer's Certificate of Installation Verification.

3.04 FIELD QUALITY CONTROL

- A. As specified in Section 26_05_00 - Common Work Results for Electrical.
- B. As specified in 26_24_14 - Group-Mounted Circuit Breaker Switchboards.

3.05 OWNER TRAINING

- A. Perform Owner Training as specified in Section 01_75_17 - Commissioning.

3.06 ADJUSTING

- A. As specified in Section 26_24_14 - Group-Mounted Circuit Breaker Switchboards.

END OF SECTION

SECTION 26_24_14

GROUP-MOUNTED CIRCUIT BREAKER SWITCHBOARDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Free standing, dead-front type metal-enclosed distribution, low voltage switchboards, utilizing group-mounted circuit protective devices.

1.02 REFERENCES

- A. National Electrical Manufacturers Association (NEMA):
 - 1. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).
- B. National Fire Protection Association (NFPA):
 - 1. 70 - National Electrical Code.
 - 2. 70E® - Standard for Electrical Safety in the Workplace®.
- C. Underwriters Laboratories, Inc. (UL):
 - 1. 891 - Switchboards.

1.03 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Anchoring and bracing.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Manufacturer of switchboard.
 - 2. Manufacturer of component parts of switchboard.
 - 3. Weight of switchboard.
 - 4. Dimensions:
 - a. Height.
 - b. Length.
 - c. Width.
 - 5. Nameplate schedule.
 - 6. Bill of material.
 - a. Description of operation: Automatic transfer system as specified in Section 26_23_01 - Service Entrance Automatic Transfer Equipment.
 - 7. Ratings:
 - a. Voltage.
 - b. Phase.
 - c. Current.

- d. Interrupting rating (circuit breakers and fuses).
 - e. Momentary current rating.
 - 8. List of recommended spare parts.
 - 9. Certification that the utility metering compartment meets the requirements of the serving electrical utility.
 - 10. Name and telephone number of manufacturer's authorized parts and repair provider.
 - 11. Furnish circuit breaker Submittals as specified in:
 - a. Section 26_28_01 - Low Voltage Molded Case Circuit Breakers.
 - 12. For equipment installed in structures designated as seismic design category C, D, E, or F, submit the following as specified in Section 01_81_50 - Design Criteria:
 - a. Manufacturer's statement of seismic qualification with substantiating test data.
 - b. Manufacturer's special seismic certification with substantiating test data.
- C. Shop Drawings:
 - 1. Layout drawings:
 - a. Complete, detailed, and scaled switchboard layout:
 - 1) Front panel.
 - 2) Sub-panels.
 - 3) Interior panels.
 - 4) Top and bottom conduit windows.
 - 2. Complete electrical wiring diagrams:
 - a. Point-to-point connections.
 - b. Indicate wire numbers.
 - c. Interfaces to other equipment.
 - 1) Detail of interface connections to automatic transfer breakers, engine generators, etc.
- D. Calculations:
 - 1. Detailed calculations or details of the actual physical testing performed on the switchboard to prove the switchboard is suitable for the seismic requirements at the Project Site.
- E. Delegated Design Submittals:
 - 1. Anchoring and bracing: Provide project-specific calculations based on support conditions and requirements to resist loads specified in Section 01_81_50 - Design Criteria:
 - a. To structures for equipment installed in structures designated as seismic design category C, D, E, or F.
 - b. For equipment installed outdoors.
- F. Installation instructions:
 - 1. Detail the complete installation of the equipment, including rigging, moving, and setting into place.
 - 2. Provide manufacturer's installation instructions.

- G. Quality Control Submittals:
 - 1. Manufacturer's representative qualifications.
 - 2. Manufacturer's Certificate of Source Testing as specified in Section 01_75_17 - Commissioning.
 - 3. Manufacturer's Certificate of Installation Verification as specified in Section 01_75_17 - Commissioning.
 - 4. Test reports.
- H. Owner Training Submittals:
 - 1. As specified in Section 01_75_17 - Commissioning.
- I. Operating and maintenance manuals:
 - 1. As specified in Section 01_78_24 - Operation and Maintenance Manuals.
 - 2. Submit operating instructions and a maintenance manual for the switchboard(s) furnished and/or installed under this Contract.
 - 3. Operating instructions:
 - a. Written descriptions must detail the operational functions of the switchboard.
 - 4. Maintenance manual:
 - a. Furnish maintenance manuals with instructions covering details pertaining to care and maintenance of equipment, as well as data identifying all parts.
 - b. Manuals to include, but are not limited to, the following:
 - 1) Adjustment and test instructions covering the steps involved in the initial test, adjustment, and start-up procedures.
 - 2) Description of the automatic transfer sequence of operation which outlines the steps following normal power failure, and fault conditions, and return of normal power conditions.
 - 3) Schematic, wiring, and external diagrams:
 - a) Furnished in a reduced 11-inch by 17-inch fully legible format.
 - 4) Report listing the installed setting of adjustable parameters for automatic transfer system.

1.05 QUALITY ASSURANCE

- A. Where indicated on the Drawings as service entrance equipment, the switchboard shall be UL labeled and listed "Suitable for Service Entrance."
- B. Sections and devices shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Ship the switchboard to the jobsite on a dedicated air ride vehicle that will allow the Contractor to utilize on-site off-loading equipment:
 - 1. Energize space heaters in NEMA 3R switchboards.
- B. Furnish temporary equipment heaters within the switchboard to prevent condensation from forming.

1.07 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS

- A. Provide a letter from the electric utility stating that the utility metering compartment meets all serving utility requirements, or provide switchboard Shop Drawings reviewed, stamped, and signed by the electric utility.
- B. Sequencing:
 - 1. Conduct the initial fault current study as specified in Section 26_05_74 - Electrical System Studies and submit results for the Engineer's review.
 - 2. After successful review of the initial fault current study, submit complete equipment Submittal.
 - 3. Conduct factory acceptance test and submit certified test results for the Engineer's review.
 - 4. Ship equipment to the Project Site after successful completion of the factory acceptance test.
 - 5. Assemble equipment in the field.
 - 6. Conduct field acceptance test and submit results for the Engineer's review.
 - 7. Submit manufacturer's certification that equipment has been properly installed and is fully functional for the Engineer's review.
 - 8. Conduct Owner Training sessions.
 - 9. Commissioning as specified in Section 01_75_17 - Commissioning.

1.09 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. Factory assembled, wired, and tested switchboards, with major components being products of a single manufacturer, including, but not limited to, circuit breakers, bus and enclosure with accessories and features specified in this Section and indicated on the Drawings.
- B. Description of sections:
 - 1. Utility metering compartment:
 - a. When indicated on the Drawings, furnish an integral utility current and voltage transformer cabinet for utility company metering.
 - b. Shall conform to all requirements of the electric utility.
 - c. Service entrance cables to enter the utility metering compartment as indicated on the Drawings.
 - 2. Pull section:
 - a. Where indicated on the Drawings, provide an incoming line pull section:
 - 1) Depth equal to that of main device section.
 - 2) Width based on manufacturer's standard for the number and size of incoming cables.
 - 3) Provide a barrier for service entrance applications.
 - 4) Dimensions cannot exceed those indicated on the Drawings.

3. Space for future devices:
 - a. Provide spaces as indicated on the Drawings.
 - b. As specified in Section 26_05_00 - Common Work Requirements for Electrical.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Provide equipment and components that are fully rated for the Site elevation and operating environment where the equipment will be installed as specified in Section 01_81_50 - Design Criteria and as indicated on the Drawings.
- B. Non-conditioned spaces:
 1. Provide additional temperature conditioning equipment to maintain the equipment temperature within a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature.
- C. Outdoor installations:
 1. Provide conditioning equipment incorporated into the equipment to maintain the enclosures within the equipment manufacturer's specified operating ranges.

2.03 MANUFACTURERS

- A. One of the following or equal:
 1. ABB.
 2. Eaton.
 3. Schneider Electric.
- B. Circuit breakers: Same manufacturer as the switchboard.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

- A. Switchboard:
 1. Furnish low voltage Class 2 switchboards as specified and indicated on the Drawings.
 2. Provide complete and functional switchboards with required controls.
 3. Furnish and install devices or accessories not described in this Section but necessary for the proper installation and operation of the equipment.
- B. Voltage ratings:
 1. Voltage level and configuration: As indicated on the Drawings.
 2. Frequency: 60 hertz.
- C. Bus:
 1. General:
 - a. Tin-plated copper.
 - b. Bus cross-section in accordance with UL heat rise requirements.

- c. Current density of 1,000 amps per square inch.
 - d. Mounted on supports of high-impact, non-tracking insulators.
 - e. Phase A-B-C bus arrangement:
 - 1) Top-to-bottom, left-to-right, front-to-back throughout the switchboard.
 - f. Symmetrical short circuit current bracing of as indicated on the Drawings.
 - g. Continuous current rating as indicated on the Drawings.
 - 2. Horizontal bus:
 - a. Provisions for future connections to additional switchboard sections.
 - 3. Ground bus:
 - a. Sized in accordance with UL 891.
 - 4. Neutral bus:
 - a. Sized for 100 percent of power bus rating.
- D. Enclosure:
- 1. General:
 - a. Self-supporting structures bolted together to form the required lineup.
 - b. All sections rear aligned.
 - c. Dead-front.
 - d. Conduit entry:
 - 1) Open bottom.
 - 2) Removable top cover.
 - 2. Frame:
 - a. Die-formed 12-gauge steel.
 - 3. Covers:
 - a. Bolt-on.
 - b. Code gauge steel.
 - c. Removable front covers.
 - 1) Held in place by captive screws.
 - 4. Rating:
 - a. NEMA Type 3R:
 - 1) Sloped roof.
 - 2) Filtered vents to provide ventilation to maintain the equipment within its operating temperature range.
 - 3) Space heaters to prevent condensation.
 - 4) Control power transformer:
 - a) Sized to power space heaters, lights, and receptacles.
 - b) Primary and secondary fusing.
 - 5) Doors:
 - a) Front and rear.
 - b) Wind stop on each door.
 - c) 3-point catch with provision for padlock.
 - d) Front to rear full depth lifting beams.
 - 6) Gasketed.
 - 7) LED light.
 - 8) 120-volt, 15-amp GFCI convenience outlet.
 - 9) Non walk-in construction.

2.07 COMPONENTS

- A. Circuit breakers:
 - 1. General:
 - a. Frame, trip, and short circuit ratings as indicated on the Drawings.
 - 2. Main circuit breaker:
 - a. 100 percent rated molded case circuit breakers as specified in Section 26_28_01 - Low Voltage Molded Case Circuit Breakers.
 - 3. Feeder breakers:
 - a. Molded case circuit breakers as specified in Section 26_28_01 - Low Voltage Molded Case Circuit Breakers.
- B. Wiring:
 - 1. Provide necessary internal wiring, fuse blocks, and terminal blocks as required.
 - 2. Number wires at each end and indicate wire numbers on Shop Drawings.
 - 3. Type SIS switchboard wire with at least 26 strands.
 - 4. Minimum wire size:
 - a. No. 14 for control circuits.
 - b. No. 12 for voltage and current transformer circuits.
 - 5. Numbered and labeled as specified in Section 26_05_53 - Identification for Electrical Systems.
- C. Control power transformers:
 - 1. Provide 480- to 120-volt control power transformers as indicated on the Drawings.
 - 2. Capacity for 125 percent of the load served.
 - 3. Protect with both primary and secondary fuses. Protect primary side with current limiting fuses.
- D. The following electrical safety devices as specified in Section 26_43_10 - Electrical Safety Devices:
 - 1. I/R window.
 - 2. Maintenance mode switch.

2.08 ACCESSORIES

- A. Metering system:
 - 1. Provide power meters as indicated on the Drawings.
 - 2. As specified in Section 26_09_13 - Electrical Power Monitoring.
- B. Surge protective devices:
 - 1. As indicated on the Drawings and as specified in Section 26_43_14 - Surge Protective Devices.
- C. Nameplates:
 - 1. Provide engraved plastic nameplates to identify:
 - a. Switchboard units.
 - b. Door mounted components.
 - c. Interior mounted devices.
 - 2. As specified in Section 26_05_53 - Identification for Electrical Systems.

3. Engraved with the circuit number and circuit name as indicated on the Drawings.
 4. Manufacturer's labels:
 - a. Each vertical section shall have a label identifying:
 - 1) Serial number.
 - 2) Shop order number.
 - 3) Bus rating.
 - 4) Vertical section reference number.
 - 5) Date of manufacture.
- D. Warning signs:
1. Voltage:
 - a. Provide a minimum of 2 warning signs on the front of the switchboard lineup and 2 on the back.
 - b. Red laminated plastic engraved with white letters approximately 1/2-inch high.
 - c. Signs shall read:
 - 1) "WARNING-HIGH VOLTAGE-KEEP OUT".
 2. Arc flash:
 - a. Provide 1 warning sign for each switchboard compartment.
 - b. Signs shall have read a minimum of:
 - 1) "DANGER ELECTRIC ARC FLASH HAZARD."
 - 2) Signs shall meet the requirements of NFPA 70E and NEC Article 110.16.
- E. Automatic transfer system:
1. As specified in Section 26_23_01 - Service Entrance Automatic Transfer Equipment.
- F. Space heaters:
1. Fused, thermostatically controlled, strip-type, operated at half voltage for long life:
 - a. 500-volt or 250-volt rated heaters at 240 volt or 120 volt, respectively.
 2. Powered from the switchboard control power transformer.
 3. Each space heater shall be powered through its own dedicated circuit breaker.
- G. Lugs:
1. For external connections of No. 6 AWG or larger.
 2. UL listed for copper or aluminum conductors.
 3. Rated for 75-degree Celsius conductors.
 4. Lugs shall be of the compression type in design requiring a hydraulic press and die for installation.

2.09 FABRICATION (NOT USED)

2.10 FINISHES

- A. Chemically clean steel surfaces before painting.
- B. Exterior color manufacturer's standard gray over phosphate-type rust inhibitor.

2.11 SOURCE QUALITY CONTROL

- A. Source Testing:
 - 1. Witnessed, virtual only.
 - 2. Completely assemble, wire and test the switchboard:
 - a. Provide groups of wires leaving the shipping-assembled equipment with terminal blocks with suitable numbering strips.
 - 3. Furnish test reports and Manufacturer's Certificate of Source Testing.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

- A. Anchoring and bracing to structures:
 - 1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
 - 2. Install anchors of type and material indicated on approved anchoring designs.
 - 3. Install anchors with embedment indicated on approved anchoring designs.

3.03 INSTALLATION

- A. Install the equipment in accordance with the accepted installation instructions and anchorage details.
- B. General:
 - 1. Furnish cables, conduit, lugs, bolts, and other accessories needed to complete the installation of the switchboard.
 - 2. Assemble and install the switchboard in the location and layout indicated on the Drawings.
 - 3. Perform Work in accordance with the manufacturer's instructions and Shop Drawings.
 - 4. Furnish components and equipment as required to complete the installation.
 - 5. Replace any hardware lost or damaged during the installation or handling to provide a complete installation.
 - 6. Install the switchboard on a raised concrete housekeeping pad:
 - a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.
 - b. Weld and/or bolt the switchboard frame to be to the leveling channels.
- C. Furnish Manufacturer's Certificate of Installation Verification.

3.04 FIELD QUALITY CONTROL

- A. As specified in Section 26_05_00 - Common Work Results for Electrical.
- B. Field electrical acceptance testing:
 - 1. As specified in Section 26_08_50 - Field Electrical Acceptance Tests.

- C. Manufacturer's services:
 - 1. Furnish the services of a factory certified technician during the start-up and adjustment period to ensure that items furnished are in proper operating condition.

3.05 OWNER TRAINING

- A. Perform Owner Training as specified in Section 01_75_17 - Commissioning.
 - 1. Number of sessions:
 - a. Operations: 1.
 - b. Maintenance: 1.

3.06 ADJUSTING

- A. Make adjustments as necessary and recommended by the manufacturer, Engineer, or testing firm.

END OF SECTION

SECTION 26_28_01

LOW VOLTAGE MOLDED CASE CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Low voltage molded case circuit breakers.

1.02 REFERENCES

- A. National Fire Protection Association (NFPA):
 - 1. 70 - National Electrical Code (NEC).
- B. Underwriters Laboratories (UL):
 - 1. 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.03 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Anchoring and bracing.

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Catalog cutsheets.
 - 2. Manufacturer's time-current curves for molded case circuit breakers furnished.
- C. Delegated Design Submittals:
 - 1. Anchoring and bracing: Provide project-specific calculations based on support conditions and requirements to resist loads specified in Section 01_81_50 - Design Criteria.
 - a. To structures for equipment installed in structures designated as seismic design category C, D, E, or F.
 - b. For equipment installed outdoors.
 - c. For wall mounted equipment weighing 125 pounds or more.
- D. Owner Training Submittals:
 - 1. As specified in Section 01_75_17 - Commissioning.

1.05 QUALITY ASSURANCE

- A. Low voltage molded case circuit breakers shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.09 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. Molded case thermal magnetic, solid-state, or motor circuit protector type circuit breakers as indicated on the Drawings and connected to form a completed system.

2.02 DESIGN AND PERFORMANCE CRITERIA (NOT USED)

2.03 MANUFACTURERS

- A. One of the following or equal:
 - 1. ABB.
 - 2. Eaton.
 - 3. Schneider Electric.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS

- A. General:
 - 1. In accordance with UL 489.
 - 2. Operating mechanism:
 - a. Quick-make, quick-break, non-welding silver alloy contacts.
 - b. Common Trip, Open and Close for multi-pole breakers such that all poles open and close simultaneously.
 - c. Mechanically trip free from the handle.
 - d. Trip indicating handle - automatically assumes a position midway between the manual ON and OFF positions to clearly indicate the circuit breaker has tripped.
 - e. Lockable in the OFF position.
 - 3. Arc extinction:
 - a. In arc chutes.
 - 4. Voltage and current ratings:
 - a. Minimum ratings as indicated on the Drawings.
 - b. Minimum frame size for 480 VAC breakers: 100 A.
 - 5. Interrupting ratings:
 - a. Minimum ratings as indicated on the Drawings.

- b. Modify as required to meet requirements of the short circuit fault analysis as specified in Section 26_05_74 - Electrical System Studies.
 - c. Not less than the rating of the assembly (panelboard, switchboard, motor control center, etc.).
- B. Motor circuit protectors:
 - 1. Instantaneous only circuit breaker as part of a listed combination motor controller.
 - 2. Each pole continuously adjustable in a linear scale with LO and HI settings factory calibrated.

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS

- A. Terminals:
 - 1. Line and load terminals suitable for the conductor type, size, and number of conductors indicated on the Drawings and in accordance with UL 489.
- B. Case:
 - 1. Molded polyester glass reinforced.
 - 2. Ratings clearly marked.
- C. Trip units:
 - 1. Provide thermal magnetic or solid-state trip units as indicated on the Drawings.
 - 2. Thermal magnetic:
 - a. Instantaneous short circuit protection.
 - b. Inverse time delay overload.
 - c. Ambient or enclosure compensated by means of a bimetallic element.
 - 3. Solid state:
 - a. With the following settings as indicated on the Drawings:
 - 1) Adjustable long time current setting.
 - 2) Adjustable long time delay.
 - 3) Adjustable short time pickup.
 - 4) Adjustable short time delay.
 - 5) Adjustable instantaneous pickup.
 - 6) Adjustable ground fault pickup as indicated on the Drawings.
 - 7) Adjustable ground fault delay as indicated on the Drawings.
 - b. Energy reducing maintenance switch on breakers 1,200 amps and above and on additional breakers as indicated on the Drawings.
 - 1) Indication on the breaker.
- D. Provide ground fault trip devices as indicated on the Drawings.
- E. Molded case circuit breakers for use in panelboards:
 - 1. Bolt-on type:
 - a. Plug-in type breakers are not acceptable.
 - 2. Ground fault trip devices as indicated on the Drawings.

2.08 ACCESSORIES

- A. Shunt trip:
 - 1. Provide a trip coil to remotely open breaker as indicated on the Drawings.
- B. Undervoltage trip:
 - 1. Electrically trips breaker when control circuit voltage falls to a preset voltage as indicated on the Drawings.
- C. Auxiliary switches:
 - 1. Provide open/closed status switches for remote monitoring of breaker as indicated on the Drawings.
- D. Alarm switches:
 - 1. Provide normally open contact that is actuated when breaker trips as indicated on the Drawings.
- E. Electrical motorized operator:
 - 1. Provide motorized breaker operator as indicated on the Drawings.

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

- A. Test breakers in accordance with:
 - 1. UL 489.
 - 2. Manufacturer's standard testing procedures.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

- A. Anchoring and bracing to structures:
 - 1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
 - 2. Install anchors of type and material indicated on approved anchoring designs.
 - 3. Install anchors with embedment indicated on approved anchoring designs.

3.03 INSTALLATION

- A. Install breakers to correspond with the accepted Shop Drawings.

3.04 FIELD QUALITY CONTROL

- A. Field electrical acceptance testing:
 - 1. As specified in Section 26_08_50 - Field Electrical Acceptance Tests.

3.05 OWNER TRAINING

- A. Perform Owner Training as specified in Section 01_75_17 - Commissioning.

3.06 ADJUSTING

- A. Adjust trip settings in accordance with the protective device coordination study as accepted by the Engineer and in accordance with the manufacturer's recommendations.
- B. Adjust motor circuit protectors in accordance with the NEC and the manufacturer's recommendation based on the nameplate values of the installed motor.

END OF SECTION

SECTION 26_36_24
TRANSFER SWITCHES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Transfer switches.

1.02 REFERENCES

- A. Abbreviations:
 - 1. ATS: Automatic transfer switch.
 - 2. MTS: Manually initiated, electrically operated transfer switch.
- B. Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).
 - 2. Underwriters Laboratories (UL):
 - a. 1008 - Transfer Switch Equipment.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. SCCR: Short-circuit current rating, the maximum short-circuit current a component and assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time.
 - 2. WCR: Withstand and closing rating, represents a transfer switch's capability to ride out a fault condition until the overcurrent protective device opens and clears the fault.

1.04 DELEGATED DESIGN

- A. As specified in Section 01_35_73 - Delegated Design Procedures.
- B. Anchoring and bracing.

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Manufacturer of transfer switch.
 - 2. Manufacturer of component parts of the ATS.
 - 3. Dimensions:
 - a. Width.
 - b. Length.

- c. Height.
 - d. Weight.
 - 4. Bill of material.
 - 5. Description of operation.
 - 6. Ratings:
 - a. Voltage.
 - b. Phase.
 - c. Current.
 - d. Number of poles.
 - e. Withstand and closing rating (WCR).
 - 7. List of recommended spare parts.
 - 8. For equipment installed in structures designated as Seismic Design Category C, D, E, or F, submit the following as specified in Section 01_81_50 - Design Criteria:
 - a. Manufacturer's statement of seismic qualification with substantiating test data.
 - b. Manufacturer's special seismic certification with substantiating test data.
- C. Shop Drawings:
 - 1. Layout drawings:
 - a. Furnish full-dimension and to-scale equipment layout drawings, which include:
 - 1) Plan, front, and side views.
 - 2) Sub-panels.
 - 3) Interior panels.
 - 4) Top and bottom conduit windows.
 - 2. Complete electrical wiring diagrams:
 - a. Point-to-point connections.
 - b. Indicate wire numbers.
 - 3. Complete interface and connection diagrams.
 - 4. Transfer equipment label indicating the short-circuit current rating (SCCR).
- D. Calculations:
 - 1. Detailed calculations or details of the actual physical testing performed on the transfer switch to prove the transfer switch is suitable for the seismic requirements at the Project Site.
- E. Delegated Design Submittals:
 - 1. Provide project-specific calculations based on support conditions and requirements to resist loads specified in Section 01_81_50 - Design Criteria:
 - a. To structures for equipment installed in structures designated as seismic design category C, D, E, or F.
 - b. For equipment installed outdoors.
 - c. For wall mounted equipment weighing 125 pounds or more.
- F. Installation instructions:
 - 1. Detail the complete installation of the equipment, including rigging, moving, and setting into place.
 - 2. Provide manufacturer's installation instructions.

- G. Quality Control Submittals:
 - 1. Manufacturer's representative qualifications.
 - 2. Manufacturer's Certificate of Source Testing as specified in Section 01_75_17 - Commissioning.
 - 3. Manufacturer's Certificate of Installation Verification as specified in Section 01_75_17 - Commissioning.
 - 4. Test reports.
- H. Owner Training Submittals:
 - 1. As specified in Section 01_75_17 - Commissioning.
- I. Operation and maintenance manuals:
 - 1. As specified in Section 01_78_24 - Operation and Maintenance Manuals.
 - 2. Operating instructions:
 - a. Printed and framed instruction chart suitable for wall hanging.
 - b. Detail the operational functions of transfer switch controls.
 - 3. Maintenance manual:
 - a. Furnish maintenance manuals with instructions covering maintenance of equipment and data identifying all parts.
 - b. Furnish information needed to maintain the transfer switch, including, but not limited to, the following:
 - 1) Instructions for testing, adjustment, and start-up.
 - 2) Detailed control instructions that outline the purpose and operation of every control device used in normal operation.
 - 3) Description of the sequence of operation that outlines the steps that follow normal power failure, transfer to standby power, return to normal power, and fault conditions.
 - 4) Schematics and wiring:
 - a) Furnished in a reduced 11-inch-by-17-inch fully legible format.
 - 5) Report listing the installed setting of adjustable parameters for the automatic transfer system.

1.06 QUALITY ASSURANCE

- A. Where indicated on the Drawings, the transfer switch shall be UL labeled and listed "Suitable for Service Entrance".

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Ship the transfer switch to the jobsite on a dedicated air-ride vehicle that will allow the Contractor to utilize on-site off-loading equipment.
- B. Furnish temporary equipment heaters within the transfer switch to prevent condensation from forming.

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.09 ADMINISTRATIVE REQUIREMENTS

- A. Utility coordination:
 - 1. Submit certifications as specified in Section 26_05_03 - Utility Coordination.
 - 2. Submit table of utility required parameters and settings for protective relays and control functions.

1.10 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide transfer switches capable of transferring load circuits from utility power to standby power and back.

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Provide equipment and components that are fully rated for the Site elevation and operating environment where the equipment will be installed as specified in Section 01_81_50 - Design Criteria and as indicated on the Drawings.
- B. Non-conditioned spaces:
 - 1. Provide additional temperature conditioning equipment to maintain the equipment temperature within a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature.
- C. Outdoor installations:
 - 1. Provide conditioning equipment incorporated into the equipment to maintain the enclosures within the equipment manufacturer's specified operating ranges.
- D. ATS sequence of operation:
 - 1. When the voltage of any normal source phase drops below 80 percent and after an adjustable time delay (0 to 6 seconds minimum), the transfer switch shall start the standby generator.
 - 2. When standby voltage reaches 90 percent of nominal, and frequency is within 2 hertz of nominal, following an adjustable time delay (0 to 10 seconds), the switch shall transfer to standby power.
 - 3. When normal power has been restored to 90 percent of nominal on all phases, following an adjustable time delay (0 to 30 minutes), the switch shall retransfer to normal power:
 - a. If the standby source fails during this time delay, the switch shall automatically retransfer to normal power.
 - 4. Following an adjustable generator cool-down timer (0 to 60 minutes), the switch shall stop the generator.

2.03 MANUFACTURERS

- A. One of the following or equal:
 - 1. ABB.
 - 2. ASCO.
 - 3. Eaton.
 - 4. Russelectric, Inc.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

- A. General:
 - 1. Capable of switching all classes of load.
 - 2. Rated for continuous duty when installed in a non-ventilated enclosure.
 - 3. Provide circuit breakers or contactors rated for continuous duty.
 - 4. Minimum transfer time for delayed transition ATS: 1 second.
 - 5. Capable of transferring successfully in either direction with 70 percent of rated voltage applied to the terminals.
 - 6. Provide automatic transfer switches with provisions for manual operation under no load.
 - 7. Transfer switch short circuit rating to be coordinated with the overcurrent protective devices at the fault current available on the line side of the transfer switch.
- B. Electrical ratings:
 - 1. Voltage, configuration, and amp ratings as indicated on the Drawings.
 - 2. WCR in accordance with UL 1008.
- C. Contacts:
 - 1. Mechanically held.
 - 2. Mechanically interlocked to prevent normal and standby sources from being closed at the same time.
 - 3. Silver alloy construction.
 - 4. Neutral contact, when indicated on the Drawings:
 - a. Same ratings as the phase contacts.
 - b. Break last and make first operation.
- D. Controls:
 - 1. MTS shall be manually initiated to transfer from one acceptable source to another acceptable source. MTS shall derive control power from the source from which it is switching.
 - 2. ATS shall have 3-phase over-voltage, under-voltage, over-frequency, and under-frequency on both normal and standby sources.
 - 3. Control panel:
 - a. Microprocessor based.
 - b. 4-line, 20-character LCD display. Displayed data shall include:
 - 1) Normal and standby source parameters.
 - 2) Diagnostic information.

- 3) Switch and timer status.
- c. Keypad for making ATS settings and operating parameters:
 - 1) Settings shall be password protected.
- d. LED display of the following:
 - 1) Normal source available.
 - 2) Connected to normal source.
 - 3) Standby source available.
 - 4) Connected to standby source.
- e. Provisions for testing ATS operation by simulating a normal source failure.
- f. Generator exerciser:
 - 1) Programmable to start the generator on a daily, weekly, monthly, or yearly basis for an adjustable period of time.
 - 2) Load or no load selectable:
 - a) When load is selected, ATS will transfer to the generator for the duration of the exercise period. Re-transfer back and cool down the generator.
 - b) When no load is selected, the ATS will run the generator for the duration of the exercise period and then stop the generator.
- 4. Status and control contacts:
 - a. Generator start/stop contact:
 - 1) Single-pole, double-throw.
 - 2) Rated for 5 amps at 30 VDC.
 - b. Status contacts:
 - 1) Single-pole, double-throw.
 - 2) Rated for 10 amps at 250 VAC.
 - 3) Provide contacts for the following:
 - a) Normal source available.
 - b) Normal source failure.
 - c) Connected to normal source.
 - d) Standby source available.
 - e) Standby source failure.
 - f) Connected to standby source.

- E. Enclosure:
 - 1. NEMA Type 3R.

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES

- A. Space heater:
 - 1. Provide a thermostatically controlled space heater in NEMA Type 3R enclosures.
 - 2. Integrally powered from the switch.

2.09 SOURCE QUALITY CONTROL

- A. Source Testing:
 - 1. Complete factory test to verify proper operation of timers, settings, and operation.
 - 2. Furnish test reports and the Manufacturer's Certificate of Source Testing.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

- A. Anchoring and bracing to structures:
 - 1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
 - 2. Install anchors of type and material indicated on approved anchoring designs.
 - 3. Install anchors with embedment indicated on approved anchoring designs.

3.03 INSTALLATION

- A. Install the equipment in accordance with the accepted installation instructions and anchorage details.
- B. General:
 - 1. Furnish components and equipment as required to complete the installation.
 - 2. Replace hardware lost or damaged during the installation or handling to provide a complete installation.
 - 3. Install the transfer switch on a raised concrete housekeeping pad:
 - a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.
 - b. Weld and/or bolt the transfer switch frame to the leveling channels.
 - 4. Provide openings in top or bottom of the enclosure for conduit only, no additional openings will be allowed:
 - a. Improperly cut holes will require that the entire panel be replaced:
 - 1) No hole closers or patches will be allowed.
- C. Furnish Manufacturer's Certificate of Installation Verification.

3.04 FIELD QUALITY CONTROL

- A. As specified in Section 26_05_00 - Common Work Results for Electrical.
- B. Field electrical acceptance testing:
 - 1. As specified in Section 26_08_50 - Field Electrical Acceptance Tests.

3.05 OWNER TRAINING

- A. Perform Owner Training as specified in Section 01_75_17 - Commissioning.
 - 1. Number of sessions:
 - a. Operations: 1.

END OF SECTION

SECTION 26_43_10

ELECTRICAL SAFETY DEVICES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Absence of voltage detectors.
 - 2. Infrared (I/R) windows.
 - 3. Arc-flash detection relays.
 - 4. Maintenance mode switches.
 - 5. Thermal monitoring.

1.02 REFERENCES

- A. Abbreviations:
 - 1. I/R: Infrared.
- B. Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).
 - 2. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC).
 - b. 70E - Standard for Electrical Safety in the Workplace.

1.03 DELEGATED DESIGN (NOT USED)

1.04 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 - 1. Manufacturer.
 - 2. Catalog cutsheets.
 - 3. Dimensions:
 - a. Height.
 - b. Length.
 - c. Width.
 - d. Weight.
 - 4. Nameplate schedule.
 - 5. Bill of material.
 - 6. Description of operation:
 - a. Outlining function and operation of each device.
 - 7. Ratings:
 - a. Voltage.
 - b. Phase.
 - c. Current.

- d. Interrupting rating (circuit breakers and fuses).
 - 8. Enclosure information:
 - a. NEMA rating.
 - b. Materials.
 - 9. List of recommended spare parts.
 - 10. Manufacturer's recommended special tools for installation and maintenance, if required.
- C. Installation instructions:
- 1. Provide manufacturer's installation instructions.
- D. Quality Control Submittals:
- 1. Manufacturer's representative qualifications.
 - 2. Manufacturer's Certificate of Source Testing as specified in Section 01_75_17 - Commissioning.
 - 3. Manufacturer's Certificate of Installation Verification as specified in Section 01_75_17 - Commissioning.
 - 4. Manufacturer's Certificate of Functional Compliance as specified in Section 01_75_17 - Commissioning.
- E. Owner Training Submittals:
- 1. As specified in Section 01_75_17 - Commissioning.
- F. Operation and maintenance manuals:
- 1. As specified in Section 01_78_24 - Operation and Maintenance Manuals.

1.05 QUALITY ASSURANCE (NOT USED)

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS (NOT USED)

1.08 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.09 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. Electrical safety devices designed, constructed, and tested in accordance with the reference standards in this Section.

2.02 DESIGN AND PERFORMANCE CRITERIA (NOT USED)

2.03 MANUFACTURERS

- A. I/R windows:
 - 1. One of the following or equal:
 - a. Flir.
 - b. Fluke.
- B. Maintenance mode switches:
 - 1. The following or equal:
 - a. Schneider Electric.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

- A. I/R windows:
 - 1. 4-inch diameter.
 - 2. Crystal lens infrared (IR) scanning window.
 - 3. Installed on each set of circuit breaker terminations, mounted on cable compartment door.
- B. Maintenance mode switch:
 - 1. With a lockable cover, clearly labeled.
 - 2. Install on the face of the equipment
 - 3. Blue light to indicate when it is engaged.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. As specified in Section 26_05_00 - Common Work Results for Electrical.
- B. Install the equipment in accordance with the manufacturer installation instructions.

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 OWNER TRAINING

- A. Perform Owner Training as specified in Section 01_75_17 - Commissioning.
 - 1. Number of sessions:
 - a. Operations 1.

END OF SECTION

SECTION 26_43_14

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. High-energy surge protective devices.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. C62.41.1 - Guide on the Surge Environment in Low-Voltage (1,000 V and less) AC Power Circuits.
 - 2. C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1,000 V and Less) AC Power Circuits.
 - 3. C62.45 - Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits.
 - 4. C62.62- Standard Test Specifications for Surge Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1,000 V and less) AC Power Circuits.
- B. International Electrotechnical Commission (IEC):
 - 1. 1000-4 - Electromagnetic Compatibility Standards for Industrial Process Measurement and Control Equipment.
- C. National Electrical Manufacturers Association (NEMA).
- D. National Fire Protection Agency (NFPA):
 - 1. 20 - Standard for the Installation of Stationary Pumps for Fire Protection.
 - 2. 70 - National Electrical Code (NEC).
 - 3. 75 - Standard for the Fire Protection of Information Technology Equipment.
 - 4. 780 - Standard for the Installation of Lightning Protection Systems.
- E. Underwriters Laboratory (UL):
 - 1. 96A - Standard for Installation Requirements for Lightning Protection Systems.
 - 2. 1283 - Standard for Electromagnetic Interference Filters.
 - 3. 1449 - Standard for Surge Protective Devices.

1.03 TERMINOLOGY

- A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
 - 1. I_n : Nominal discharge current.
 - 2. MCOV: Maximum continuous operating voltage.
 - 3. MOV: Metal oxide varistor.
 - 4. SAD: Silicon avalanche diode.

5. SCCR: Short circuit current rating.
6. SPD: Surge protective device.
7. VPR: Voltage protection rating.

1.04 DELEGATED DESIGN (NOT USED)

1.05 SUBMITTALS

- A. Furnish Submittals as specified in Section 01_33_00 - Submittal Procedures.
- B. Product data:
 1. Furnish complete product data confirming detailed compliance or exception statements to all provisions of this Section.
 2. Manufacturer's catalog cutsheets indicating:
 - a. Manufacturer and model numbers.
 - b. Ratings of each SPD, including, but not limited to:
 - 1) Short circuit current rating.
 - 2) Nominal discharge current.
 - 3) Maximum continuous operating voltage.
 - 4) Voltage protection rating.
 - 5) System voltage.
 - 6) System frequency.
 - 7) Surge current capacity.
 3. Submit independent test data from a nationally recognized testing laboratory verifying the following:
 - a. Overcurrent protection.
 - b. UL 1449.
- C. Shop Drawings:
 1. Provide electrical and mechanical drawings by the manufacturer that detail:
 - a. Unit dimensions.
 - b. Weights.
 - c. Components.
 - d. Field connection locations.
 - e. Mounting provisions.
 - f. Connection details.
 - g. Wiring diagram.
- D. Quality Control Submittals:
 1. Manufacturer's representative qualifications.
 2. Manufacturer's Certificate of Source Testing as specified in Section 01_75_17 - Commissioning.
- E. Owner Training Submittals:
 1. As specified in Section 01_75_17 - Commissioning.
- F. Operation and maintenance manuals:
 1. As specified in Section 01_78_24 - Operation and Maintenance Manuals.
 2. Provide the manufacturer's manual with installation, start-up, and operating instructions for the specified system.

1.06 QUALITY ASSURANCE

- A. Provide SPD units that are designed, manufactured, tested and installed in accordance with the following codes and standards:
 - 1. IEEE C62.41.1, C62.41.2, C62.45, C62.62.
 - 2. Federal Information Processing Standards Publication 94 (FIPS PUB 94).
 - 3. NEMA.
 - 4. NFPA 20, 70, 75, and 780.
 - 5. UL 1449 current edition and UL 1283.
 - 6. IEC 1000-4.
- B. Provide surge protective devices that are suitable for application in IEEE C62.41.1, C62.41.2 Category A, B, and C3 environments, as tested to IEEE C62.45.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

- A. As specified in Section 01_81_50 - Design Criteria.

1.09 ADMINISTRATIVE REQUIREMENTS

- A. Sequencing:
 - 1. Coordinate with and provide SPD equipment to the electrical equipment manufacturer before final assembly and factory testing.

1.10 WARRANTY

- A. As specified in Section 01_78_36 - Warranties and Bonds.
- B. Extended warranty:
 - 1. Furnish a manufacturer's standard parts and labor warranty from date of shipment against any part failure when installed in accordance with the manufacturer's instructions, UL listing requirements, and any applicable national, state, or local electrical codes.
 - 2. Warranty shall include:
 - a. Direct, factory trained employees must be available within 48 hours for assessment of the problem.
 - b. A 24-hour toll-free 800-number for warranty support.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

- A. Provide surge protection as indicated on the Drawings.

2.03 MANUFACTURERS

- A. One of the following or equal:
1. ABB.
 2. Eaton.
 3. Southern Tier Technologies.
 4. Schneider Electric.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

- A. Provide Type 1 or Type 2 SPD units as required for the locations indicated on the Drawings.
- B. Electrical requirements:
1. SPD ratings are to be consistent with the nominal system operating voltage, phase, and configuration as indicated on the Drawings.
 2. MCOV:
 - a. For the SPD and all components in the suppression path (including all MOVs, SADs, and selenium cells): Greater than 115 percent of the nominal system operating voltage.
 3. Operating frequency:
 - a. 47 to 63 hertz.
 4. SCCR:
 - a. 65 kAIC minimum, but not less than the equipment it is connected to as indicated on the Drawings.
 - b. Marked on the SPD in accordance with UL 1449 and the NEC.
 5. Nominal discharge current I_n :
 - a. 20 kA.
 6. Maximum VPR:

Modes	240/120 3W	208Y/120	480Y/277	480 V
L-N, L-G, N-G	700	700	1,200	1,800
L-L	1,200	1,200	2,000	1,800

7. Peak surge current:
 - a. Service entrance locations:
 - 1) 240 kA per phase minimum.
 - 2) 120 kA per mode minimum.
 - b. Branch locations:
 - 1) 120 kA per phase, minimum.
 - 2) 60 kA per mode minimum.
- C. Protection modes:
1. Provide SPD protection modes as follows:
 - a. Line to neutral (L-N) where applicable.
 - b. Line to ground (L-G).
 - c. Neutral to ground (N-G), where applicable.

- D. Environmental requirements:
 - 1. Storage temperature:
 - a. -40 to 122 degrees Fahrenheit.
 - 2. Operating temperature:
 - a. 32 to 140 degrees Fahrenheit.
 - 3. Relative humidity:
 - a. 5 to 95 percent.
 - 4. Audible noise:
 - a. Less than 45 dBA at 5 feet (1.5 m).
 - 5. Operating altitude:
 - a. Zero to 12,000 feet above sea level.

2.07 COMPONENTS

- A. Enclosure:
 - 1. Located in electrical equipment as indicated on the Drawings.
- B. Internal connections:
 - 1. Provide low impedance copper plates for intra-unit connections:
 - a. Attach surge modules using bolted connections to the plates for low impedance connections.
 - 2. Size connections, conductors, and terminals for the specified surge current capacity.
- C. Surge diversion modules:
 - 1. MOV:
 - a. Where multiple MOVs are used in parallel, utilize computer matched MOVs to within 1 volt variance and tested for manufacturer's defects.
- D. Overcurrent protection:
 - 1. Individually fuse components, including suppression, filtering, and monitoring components:
 - a. Rated to allow maximum specified nominal discharge current capacity.
 - b. Overcurrent protection that limits specified surge currents is not acceptable.
- E. Connections:
 - 1. Provide terminals to accommodate wire sizes up to #2 AWG.

2.08 ACCESSORIES

- A. Unit status indicators:
 - 1. Provide red and green solid-state indicators, with printed labels, on the front cover to redundantly indicate on-line unit status:
 - a. The absence of the green light and the presence of the red light indicate that surge protection is reduced and service is needed to restore full operation.
 - b. Indicates the status of protection on each mode or phase.

- B. Dry contacts for remote monitoring:
 - 1. Electrically isolated Form C dry contacts (1 A/125 VAC, or 2 A/24 VDC) for remote monitoring of system integrity, and indication of under voltage, phase and/or power loss.
- C. Provide an audible alarm which activates under any fault condition:
 - 1. Alarm On/Off switch to silence the alarm.
 - 2. A visible LED will confirm whether alarm is On or Disabled.
 - 3. Locate both switches and the audible alarm on the unit's front cover.
- D. Provide transient counter to count transient voltage surges:
 - 1. LCD readout located on the unit's front cover.
 - 2. Counter to utilize batteries with a 10-year nominal life or non-volatile memory to maintain accurate counts in the event of power loss.
- E. Provide an integral disconnect switch located in line with the SPD enclosure:
 - 1. Manual operator.
 - 2. Switch shall disconnect ungrounded circuit conductors from the SPD.
 - 3. Capable of withstanding, without failure, the maximum published surge current magnitude and short circuit current without failure or damage to the switch.

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

- A. Source Testing:
 - 1. Perform manufacturer's standard factory test:
 - a. Perform testing in accordance with UL 1449.
 - 2. Furnish test reports and Manufacturer's Certificate of Source Testing.
- B. Permanently affix surge rating to the SPD.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

- A. Follow the manufacturer's recommended installation practices and comply with applicable codes.
- B. Special techniques:
 - 1. Do not subject SPD to insulation resistance testing.

3.04 FIELD QUALITY CONTROL

- A. Field electrical acceptance testing:
 - 1. As specified in Section 26_08_50 - Field Electrical Acceptance Tests.

3.05 OWNER TRAINING

- A. Perform Owner Training as specified in Section 01_75_17 - Commissioning.
 - 1. Number of sessions:
 - a. Operations: 1.

END OF SECTION

APPENDIX A - ONELINE DIAGRAM 1 - PRE-PURCHASE SCOPE



