South Valley
WATER RECLAMATION FACILITY

MCC REPLACEMENT PROJECT

CLIENT PROJECT NO. 202633

MARCH 2026

VOLUME 1 OF 2

BID SUBMITTAL

CONTRACT DOCUMENTS

BIDDING REQUIREMENTS, CONTRACT FORMS,

CONDITIONS OF THE CONTRACT, GENERAL REQUIREMENTS

Digitally signed by Christopher Alan Carvalho
Contact Info: Carollo Engineers, Inc.
Date: 2026.03.26 08:59:08-06'00'

Bids will be received at the office of South Valley Water Reclamation Facility located at

7495 South 1300 West, West Jordan, Utah 84084

until 2:00 p.m. May 12, 2026

SECTION 00020
CONTRACT DOCUMENTS TABLE OF CONTENTS

BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT

SECTION 00030 - NOTICE INVITING BIDS

RECEIPT OF BIDS: Sealed Bids will be received at the office of the South Valley Water Reclamation Facility; OWNER of the WORK located at 7495 South 1300 West, West Jordan, Utah 84084, until 2:00 PM on Tuesday, May 12, 2026, for construction of South Valley Water Reclamation Facility's "MCC REPLACEMENT PROJECT". Any Bids received after the specified time and date will not be considered.

OPENING OF BIDS: The Bids will be publicly opened and read at 2:00 PM, Tuesday, May 12, 2026, at the above-mentioned office of the OWNER.

COMPLETION OF WORK: The WORK shall be completed as described below:

a) Contractor shall demolish and remove existing equipment to be replaced, and install OWNER-procured motor control centers and automatic transfer switches. Contractor shall provide all materials required for the Work described. The Work shall be completed by December 15, 2026.

DESCRIPTION OF WORK: The project consists of the following Items:

a) The Work consists of replacement of 13 motor control centers with OWNER-procured motor control centers and modification of one existing motor control center. Replacement of existing fiber optic cables.
b) In addition, the Work includes keeping the OWNER's facility operational using mobile generators and temporary motor control centers as required to comply with the special project constraints.

SITE OF WORK: The site of the WORK is located at the OWNER's water reclamation facility at 7495 South 1300 West, West Jordan, Utah.

OBTAINING CONTRACT DOCUMENTS: The Contract Documents are entitled "South Valley Water Reclamation Facility – MCC Replacement Project".

Contract Documents for bidding may be downloaded from www.svwater.com free of charge. Electronic files may be downloaded commencing on March 25, 2026**.**
Printed Contract Documents are not available.
BID SECURITY: Each Bid shall be accompanied by a certified check or cashier's check or Bid Bond in the amount of 5 percent of the Total Bid Price payable to the OWNER as a guarantee that the Bidder, if its Bid is accepted, will promptly execute the Agreement. A bid shall not be considered unless one of the forms of Bidder's security is enclosed with it.

BIDS TO REMAIN OPEN: The Bidder shall guarantee the Total Bid Price for a period of 45 calendar days from the date of bid opening.

MANDATORY PRE-BID VISIT (CONFERENCE) TO WORK SITE: For a bid to be considered complete, prospective bidders are **required** to attend a pre-bid walk through of the proposed work site which will be conducted by the OWNER at 1:00 PM on Tuesday, April 7, 2026. The object of the walk through is to acquaint bidders with the site conditions. The pre-bid visit will start at the office of the OWNER located at 7495 South 1300 West, West Jordan City, Utah. Follow-up visits by prospective bidders and subcontractors are available by appointment only. Contact Taigon Worthen, P.E. with SVWRF for appointments. Bids will not be accepted from Bidders that do not attend the mandatory pre-bid conference.

PROJECT ADMINISTRATION: Technical communications relative to this WORK shall be directed to the ENGINEER prior to opening of the Bids. Communications relative to the Bid Documents shall be directed to the OWNER.

CAROLLO ENGINEERS, INC.
10822 W. Toller Drive, Suite 200
Littleton, CO 80127
Telephone: 303-378-5695
e-mail: ccarvalho@carollo.com
Attention: Chris Carvalho, P.E.

SOUTH VALLEY WATER RECLAMATION FACILITY
7495 South 1300 West
West Jordan, Utah 84084
Telephone: 801-495-5469
e-mail: tworthen@svwater.com
Attention: Taigon Worthen, P.E.

OWNER'S RIGHTS RESERVED: The OWNER reserves the right to reject any or all bids, to waive any informality in a bid, and to make awards to the lowest responsive, responsible bidder as the OWNER in its sole discretion shall determine may best serve the interest of the OWNER.

- END OF NOTICE INVITING BIDS -

SECTION 00100 - INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS. Terms used in these Instructions to Bidders and the Notice Inviting Bids which are defined in the General Conditions have the meanings assigned to them in the General Conditions. The term "Bidder" means one who submits a Bid directly to OWNER, as distinct from a sub-bidder, who submits a price or quote to a Bidder.

2. INTERPRETATIONS AND ADDENDA.

2.1 All questions about the meaning or intent of the Contract Documents are to be directed to the ENGINEER. Additions, deletions, or revisions to the Contract Documents considered necessary by the ENGINEER in response to such questions will be issued by Addenda, emailed, or delivered to all parties recorded by the OWNER as having received the Contract Documents. Questions received less than 5 days prior to the date of Bids may not be answered. Only answers to such questions issued by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

2.2 Addenda may also be issued to make other additions, deletions, or revisions to the Contract Documents.

2.3 Bidders shall make no special interpretation or inference of intent from differing formats in the Technical Specifications.

3. BIDDER'S EXAMINATION OF CONTRACT DOCUMENTS AND SITE.

3.1 It is the responsibility of each Bidder before submitting a Bid:

A. To examine thoroughly the Contract Documents and other related data identified in the Bidding Documents (including "technical" data referred to below);

B. To visit the site to become familiar with local conditions that may affect cost, progress, or performance, including attending the Pre-Bid Site Visit (Conference), of the WORK;

C. To consider federal, state, and local Laws and Regulations that may affect cost, progress, or performance of the WORK;

D. To study and carefully correlate the Bidder's observations with the Contract Documents; and

E. To notify the OWNER of all conflicts, errors, ambiguities, or discrepancies in or between the Contract Documents and such other related data.

3.2 (Not Used)

3.3 It is also the responsibility of each Bidder before submitting a Bid to examine thoroughly those reports of physical conditions in or relating to existing surface and subsurface conditions (except underground utilities as defined in Article 1 of the General Conditions) which are at or adjacent to the site and which were utilized by the OWNER in the preparation of the Contract Documents. Copies of such report and drawings are available for information at the office of the OWNER.

3.4 Information and data reflected in the Contract Documents with respect to Underground Utilities at or contiguous to the site are based upon information and data furnished to the OWNER by the owners of such Underground Utilities or others, and the OWNER does not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary General Conditions or Section 01783 - Selective Alterations and Demolition.

3.5 Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders on subsurface conditions, Underground Utilities, and other physical conditions, and possible changes in the Contract Documents due to differing conditions appear in Paragraphs 4.02, 4.03, and 4.04 of the General Conditions.

3.6 Before submitting a Bid, each Bidder will, at Bidder's own expense, make or obtain any additional examinations, investigations, explorations, tests, and studies and obtain any additional information and data which pertain to the physical conditions (surface, subsurface, and Underground Utilities) at or contiguous to the site or otherwise which may affect cost, progress, or performance of the WORK and which the Bidder deems necessary to determine its Bid for performing the WORK in accordance with the time, price, and other terms and conditions of the Contract Documents.

3.7 On reasonable request in advance, the OWNER will provide each Bidder access to the site to conduct such examinations, investigations, explorations, tests, and studies as each Bidder deems necessary for submission of a Bid. Location of any excavation or boring shall be subject to prior approval of OWNER and applicable agencies. Bidder shall fill all holes, restore all pavement to match existing structural section, and shall clean up and restore the site to its former condition upon completion of such explorations. OWNER reserves the right to require Bidder to execute an Access Agreement with the OWNER prior to accessing the site.

3.8 The lands upon which the WORK is to be performed, rights-of-way, and easements for access thereto and other lands designated for use by the CONTRACTOR in performing the WORK are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities or storage of materials and equipment are to be provided by the CONTRACTOR. Easements for permanent structures or permanent changes in existing structures are to be obtained and paid for by the OWNER unless otherwise provided in the Contract Documents.

3.9 The submission of a Bid will constitute an absolute representation by the Bidder that the Bidder has complied with every requirement of this Paragraph 3 and the following:

A. That the Bid is premised upon performing the WORK required by the Contract Documents without exception and such means, methods, techniques, sequences, or procedures of construction (if any) as may be required by the Contract Documents;

B. That Bidder has given the OWNER written notice of all conflicts, errors, ambiguities, and discrepancies in the Contract Documents and the written resolution thereof by the OWNER is acceptable to the Bidder; and

C. That the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the WORK.

4. BID FORMS. The Bid shall be submitted on the Bid Forms bound herein. All blanks on the Bid Forms shall be completed in ink. All names must be printed below the signatures. The Bid shall be submitted in a sealed envelope which shall be plainly marked in the upper left hand corner with the name and address of the Bidder and shall bear the words "BID FORM" followed by the title of the Contract Documents for the WORK, the name of the OWNER, the address where Bids are to be delivered or mailed to, and the date and hour of opening of Bids.

5. CERTIFICATES.

5.1 Bids by corporations must be executed in the corporate name by the president, a vice-president, or other corporate officer. Such Bid shall be accompanied by the enclosed Certificate of Authority to sign, attested by the secretary or assistant secretary, and with the corporate seal affixed. The corporate address and state of incorporation must appear below the signature.

5.2 Bids by partnerships must be executed in the partnership name and be signed by a managing partner, accompanied by the enclosed Certificate of Authority to sign, and his/her title must appear under the signature and the official address of the partnership must appear below the signature.

5.3 Bids by joint ventures must be executed in the joint venture name and be signed by a joint venture managing partner, accompanied by the enclosed Certificate of Authority to sign, and his/her title must appear under the signature and the official address of the joint venture must appear below the signature.

6. DISQUALIFICATION OF BIDDERS. More than one Bid from an individual, firm, partnership, corporation, or association under the same or different names will not be considered. If the OWNER believes that any Bidder has financial interest in more than one Bid for the WORK contemplated, all Bids in which such Bidder is interested will be rejected. If the OWNER reasonably believes that collusion exists among the Bidders, all Bids will be rejected. A party who has quoted prices to a Bidder is not hereby disqualified from quoting prices to other Bidders, but is disqualified from submitting a Bid directly for the WORK.

7. QUANTITIES OF WORK. The quantities of work or material stated in unit price items of the Bid are supplied only to give an indication of the general scope of the WORK; the OWNER does not expressly or by implication agree that the actual amount of work or material will correspond therewith, and reserves the right after award to increase or decrease the quantity of any unit price item of the WORK by an amount up to and including 25 percent of any Bid item, without a change in the unit price, and shall include the right to delete any Bid item in its entirety, or to add additional Bid items up to and including an aggregate total amount not to exceed 25 percent of the Bid price.

8. COMPETENCY OF BIDDERS. Only qualified and properly qualifying licensed CONTRACTORS specializing in electrical construction may submit a bid for the performance of the WORK.

9. SUBMISSION OF BIDS. The Bid shall be delivered by the time and to the place stipulated in the Notice Inviting Bids. It is the Bidder's sole responsibility to see that its Bid is received in proper time and at the proper place.

10. BID SECURITY, BONDS, AND INSURANCE. Each Bid shall be accompanied by a certified or cashier's check or approved Bid Bond in the amount stated in the Notice Inviting Bids. Said check or bond shall be made payable to the OWNER and shall be given as a guarantee that the Bidder, if awarded the WORK, will enter into an Agreement with the OWNER, and will furnish the necessary insurance certificates, Payment Bond, and Performance Bond; each of said bonds to be in the amount stated in the Supplementary General Conditions. In case of refusal or failure to enter into said Agreement, the check or Bid Bond, as the case may be, shall be forfeited to the OWNER. If the Bidder elects to furnish a Bid Bond as its Bid security, the Bidder shall use the Bid Bond form bound herein, or one conforming substantially to it in form. Bid Bonds shall comply with the requirements applicable to payment and performance bonds in the General Conditions.

11. DISCREPANCIES IN BIDS. In the event there is more than one Bid item in a Bid Schedule, the Bidder shall furnish a price for all Bid items in the Schedule, and failure to do so will render the Bid non-responsive and shall cause its rejection. In the event there are unit price Bid items in a Bidding schedule and the amount indicated for a unit price Bid item does not equal the product of the unit price and quantity, the unit price shall govern and the amount will be corrected accordingly, and the BIDDER shall be bound by said correction. In the event there is more than one Bid item in a Bid Schedule and the total indicated for the Schedule does not agree with the sum of the prices Bid on the individual items, the prices Bid on the individual items shall govern and the total for the Schedule will be corrected accordingly, and the BIDDER shall be bound by said correction.

12. MODIFICATIONS AND UNAUTHORIZED ALTERNATIVE BIDS. Unauthorized conditions, limitations, or provisos attached to the Bid shall render it informal and may cause its rejection as being non-responsive. The Bid forms shall be completed without interlineations, alterations, or erasures in the printed text. Alternative Bids will not be considered unless called for. Oral, telegraphic, telephonic or electronic Bids or modifications will not be considered.

13. WITHDRAWAL OF BID. The Bid may be withdrawn by the Bidder by means of a written request, signed by the Bidder or its properly authorized representative. Such written request must be delivered to the place stipulated in the Notice Inviting Bids for receipt of Bids prior to the scheduled closing time for receipt of Bids.

14. AWARD OF CONTRACT. Award of the contract, if awarded, will be made to the lowest responsive, responsible Bidder whose Bid complies with the requirements of the Contract Documents. Unless otherwise specified, any such award will be made within the period stated in the Notice Inviting Bids that the bids are to remain open. Unless otherwise indicated, a single award will be made for all the Bid items in an individual Bid Schedule.

15. RETURN OF BID SECURITY. Within 14 days after award of the contract, the OWNER will, if requested, return the Bid securities accompanying such Bids that are not being considered in making the award. All other Bid securities will be held until the Agreement has been finally executed. They will then be returned, if requested, to the respective Bidders whose Bids they accompany.

16. EXECUTION OF AGREEMENT. The Bidder to whom award is made shall execute a written Agreement with the OWNER on the form of agreement provided, shall secure all insurance, and shall furnish all certificates and bonds required by the Contract Documents within 14 calendar days after receipt of the agreement forms from the OWNER. Failure or refusal to enter into an Agreement as herein provided or to conform to any of the stipulated requirements in connection therewith shall be just cause for annulment of the award and forfeiture of the Bid security. If the lowest responsive, responsible Bidder refuses or fails to execute the Agreement, the OWNER may award the Contract to the second lowest responsive, responsible Bidder. If the second lowest responsive, responsible Bidder refuses or fails to execute the Agreement, the OWNER may award the contract to the third lowest responsive, responsible Bidder. On the failure or refusal of such second or third lowest Bidder to execute the Agreement, each such Bidder's Bid securities shall be likewise forfeited to the OWNER.

17. LIQUIDATED DAMAGES. Provisions for liquidated damages, if any, are set forth in the Agreement.

18. PREFERENCE FOR RESIDENT CONTRACTORS. The OWNER will apply the provisions of Utah Procurement Code 63G-6-405. titled Preference for Resident Contractors (Utah Code -- Title 63G -- Chapter 6) wherein it is stated “(2) (a) When awarding contracts for construction, a public procurement unit shall grant a resident contractor a reciprocal preference as against a nonresident contractor from any state that gives or requires a preference to contractors from that state. (b) The amount of the reciprocal preference shall be equal to the amount of the preference applied by the state of the nonresident contractor.”

- END OF INSTRUCTIONS TO BIDDERS -

SECTION 00300 – BID FORMS

BID

BID TO: South Valley Water Reclamation Facility

1. The undersigned Bidder proposes and agrees, if this Bid is accepted to enter into an Agreement with the OWNER in the form included in the Contract Documents to perform the WORK as specified or indicated in said Contract Documents entitled "South Valley Water Reclamation Facility – MCC Replacement Project".
2. Bidder accepts all of the terms and conditions of the Contract Documents, including without limitation those in the Notice Inviting Bids and Instructions to Bidders, dealing with the dispositions of the Bid security.
3. This Bid will remain open for the period stated in the "Notice Inviting Bids" unless otherwise required by law. Bidder will enter into an Agreement within the time and in the manner required in the "Notice Inviting Bids" and the "Instructions to Bidders", required by the Contract Documents.
4. Bidder has examined copies of all the Contract Documents including the following Addenda (receipt of all of which is hereby acknowledged):

Number	Date
_____	_____
_____	_____
_____	_____

Failure to acknowledge addenda shall render the bid non-responsive and shall be cause for its rejection.

5. Bidder has familiarized itself with the nature and extent of the Contract Documents, WORK, site, locality where the WORK is to be performed, the legal requirements (federal, state, and local laws, ordinances, rules, and regulations), and the conditions affecting cost, progress or performance of the WORK and has made such independent investigations as Bidder deems necessary.

To all the foregoing, and including all Bid Forms contained in the Bid, said Bidder further agrees to complete the WORK required under the Contract Documents within the Contract Time stipulated in said Contract Documents, and to accept in full payment therefore the Contract Price based on the Total Bid Price(s) named in the aforementioned Bid forms.

Dated: _____ Bidder: _____

By: _____

Title: _____

BID CERTIFICATE

(if Corporation)

STATE OF)

) SS:

COUNTY OF)

I HEREBY CERTIFY that a meeting of the Board of Directors of the _____

_____

_____
a corporation existing under the laws of the State of _____, held on _____, 20 _____, the following resolution was duly passed and adopted:

"RESOLVED, that _____, as _____ of this Corporation, be and is hereby authorized to execute the Bid dated _____, 20___, to the South Valley Water Reclamation Facility by this Corporation and that his/her execution thereof, attested by the Secretary of this Corporation, and with the Corporate Seal affixed, shall be the official act and deed of this Corporation."

I further certify that said resolution is now in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the corporation this _____, day of _____, 20___.

_____
Secretary

(SEAL)

BID CERTIFICATE

(if Partnership)

STATE OF)

) SS:

COUNTY OF)

I HEREBY CERTIFY that a meeting of the Partners of the _____

_____

_____
a partnership existing under the laws of the State of _____, held on _____, 20 _____, the following resolution was duly passed and adopted:

"RESOLVED, that _____, as _____ of the Partnership, be and is hereby authorized to execute the Bid dated_____, 20___, to the South Valley Water Reclamation Facility by this Partnership and that his/her execution thereof, attested by the _____ shall be the official act and deed of this Partnership."

I further certify that said resolution is now in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand this _____, day of _____, 20___.

_____

BID CERTIFICATE

(if Joint Venture)

STATE OF)

) SS:

COUNTY OF)

I HEREBY CERTIFY that a meeting of the Principals of the _____

_____

_____
a joint venture existing under the laws of the State of _____, held on _____, 20 _____, the following resolution was duly passed and adopted:

"RESOLVED, that _____, as _____of the Joint Venture, be and is hereby authorized to execute the Bid dated_____, 20___, to the "South Valley Water Reclamation Facility by this Joint Venture and that his/her execution thereof, attested by the _____ shall be the official act and deed of this Joint Venture."

I further certify that said resolution is now in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the corporation this _____, day of _____, 20___.

_____

LIST OF SUBCONTRACTORS

The Bidder shall list below the name and the location of the place of business of each Subcontractor who will perform work or labor or render service to the prime contractor in or about the construction of the work or improvement, or a Subcontractor who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications, in an amount in excess of one-half of 1 percent of the prime contractor's total bid or ten thousand dollars ($10,000), whichever is greater. The Bidder shall also list below the portion of the WORK which will be performed by each Subcontractor under its contract. The prime contractor shall list only one Subcontractor for each portion as is defined by the prime contractor in its bid. The prime contractor shall submit information (see next page) required of specialty subcontractors which are proposed to do HVAC Work, Mechanical Work, Structural Work or Electrical Work, if any.

The Bidder's attention is directed to the provisions of Paragraph entitled "Subcontract Limitations," of the Supplementary General Conditions which stipulates the percent of the WORK to be performed with the Bidder's own forces. Failure to comply with this requirement will render the Bid non-responsive and may cause its rejection.

Work to be Performed	Subcontr. License Number	Percent of Total Bid	Subcontractor's Name and Address
1. _____	_____	_____	_____
2. _____	_____	_____	_____
3. _____	_____	_____	_____
4. _____	_____	_____	_____

Note: Attach additional sheets if required.

INFORMATION REQUIRED OF SPECIALTY SUBCONTRACTORS

The Bidder shall furnish the following information for each specialty subcontractor. Additional sheets shall be attached as required. Failure to complete Item Nos. 1, 2, and 3, will cause the Bid to be non-responsive and may cause its rejection.

(1) SPECIALTY SUBCONTRACTOR's name and address:

_____

_____

_____

(2) SPECIALTY SUBCONTRACTOR's license:

Primary Classification _____

State License No. and Expiration Date _____

Specialty classifications held, if any: _____

Name of Licensee, if different from (1) above:

_____

_____

_____

.

(3) ATTACH TO THIS BID a list of the 5 most recent construction contracts or subcontracts completed by the SPECIALTY SUBCONTRACTOR involving Mechanical, Structural or Electrical Work of similar type and comparable value at Municipal Water Treatment Plants or Municipal Wastewater Treatment Plants. The list shall include the following information as a minimum:

- Names, address, and telephone number of owner.
- Name of Project.
- Location of Project.
- Brief description of the work involved.
- Contract amount.
- Date of completion of the contract.
- Name, address, and telephone number of architect or engineer.
- Name of owner's project engineer.

INFORMATION REQUIRED OF BIDDER

The Bidder shall furnish the following information. Additional sheets shall be attached as required. Failure to complete Item Nos. 1, 3, and 6, will cause the Bid to be non-responsive and may cause its rejection.

(1) CONTRACTOR's name and address:

_____

_____

_____

(2) CONTRACTOR'S telephone number: _____

(3) CONTRACTOR's fax number: _____

(4) CONTRACTOR's license: Primary Classification _____

State License No. and Expiration Date _____

Specialty classifications held, if any: _____

Name of Licensee, if different from (1) above: _____

_____

_____

(5) Name, address, and telephone number of surety company and agent who will provide the required bonds on this contract:

_____

_____

_____

(6) ATTACH TO THIS BID a financial statement, references, and other information, sufficiently comprehensive to permit an appraisal of CONTRACTOR's current financial condition.

NONCOLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER

AND SUBMITTED WITH BID

STATE OF)

) SS:

COUNTY OF)

_____, being first duly sworn, deposes and says that he or she is _____ of_____ the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit or cost element of awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

Signed: _____

Subscribed and sworn to before me

this _____day of _____, 20____

_____

Notary Public in and for the
County of _____
State of _____

(SEAL)

BID BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____as Principal, and _____as Surety, are held and firmly bound unto the South Valley Water Reclamation Facility hereinafter called "OWNER," in the sum of _____dollars, for the payment of which sum, well and truly to be made, we jointly and severally bind ourselves, our heirs, executors, administrators, successors, and assigns firmly by these presents.

WHEREAS, said Principal has submitted a Bid to said OWNER to perform the WORK required under the bidding schedule(s) of the OWNER's Contract Documents entitled "South Valley Water Reclamation Facility – MCC Replacement Project".

NOW THEREFORE, if said Principal is awarded a contract by said OWNER and, within the time and in the manner required in the "Notice Inviting Bids" and the "Instruction to Bidder" enters into a written Agreement on the form of agreement bound with said Contract documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond, and performs in all other respects the agreement created by this bid, then this obligation shall be null and void, otherwise it shall remain in full force and effect. The Surety stipulates and agrees that the obligation of said Surety shall in no way be impaired or affected by an extension of the time within which the OWNER may accept such bid and Surety further waives notice of any such extension. In the event suit is brought upon this bond by said OWNER and OWNER prevails, said Principal and Surety shall pay all costs incurred by said OWNER in such suit, including reasonable attorney's fees and costs to be fixed by the court.

SIGNED AND SEALED, this _____day of _____, 20_____

_____ (SEAL) _____ (SEAL)

(Principal) (Surety)

By: _____ By: _____

(Signature) (Signature)

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

- END OF BID FORMS -

SECTION 00310 - BID SCHEDULES

PART 1 – GENERAL

1.01 CONSTRUCTION CONTRACT

A. Name of Project: South Valley Water Reclamation Facility - MCC Replacement Project.

1.02 SCHEDULES TO BE ADDED TO THE AGREEMENT

A. This Bid Schedule contains the schedules of prices which will be incorporated into the Agreement by reference.

1.03 TAXES

A. The Bidder agrees that all sales, consumer, use, and other similar taxes are included in the stated bid prices for the WORK, unless provision is made herein for the Bidder to separately itemize the estimated amount of tax.

1.04 SCHEDULES OF PRICES

A. Schedule A: Base Lump Sum Bid. This item includes all of the WORK for the project as specified and shown on the Contract Documents. Bidder shall complete Schedule A in its entirety (see next page).

SCHEDULE A
MCC Replacement Project

Item No.	Description	Price in Figures ($)
1	Assignment of the Agreement for OWNER pre-purchased motor control centers	$
2	All other costs required to complete all Work in the Contract Documents not covered by the other Line Items listed above.	$
Total Lump Sum Bid Price		$

Bid Schedule Total In Words: _____

[1]Costs for selected sole-sourced equipment have been predetermined, and pricing is provided where applicable and is for all the units shown and includes submittals, O&M manuals, commissioning and shipping costs. Copies of the respective proposals are provided in the appendix. Where given, use that pricing to determine the total cost. Otherwise obtain and provide pricing from vendors of the Bidder's choosing which conform to the specified requirements. Add sales taxes and other appropriate fees as required. See the following table for a listing of sole-sourced equipment and vendor information. Contractor shall purchase the designated equipment from the vendors listed below at the prices given above.

Sole-Sourced Equipment and Vendor Information

Item No.	Description	Vendor
1	Rockwell Motor Control Centers and Transfer Switches	Douglas Windward Codale 5225 West 2400 South Salt Lake City, Utah 84120 D. (801) 975-5553 M. (801) 608-1400

- END OF BID SCHEDULES -

SECTON 00340
LIST OF SUBCONTRACTORS

The Bidder shall list below the name and the location of the place of business of each Subcontractor who will perform work or provide labor or render services to the prime contractor in or about the construction of the work or improvement, or a Subcontractor who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in plans and specifications, in an amount in excess of one-half of one percent (0.50%) of the prime contractor's total bid, or $10,000.00, whichever figure is greater. The Bidder shall also list below the proportion of the WORK which will be performed by each Subcontractor under its contract. The prime contractor shall list only one Subcontractor for each portion as is defined by the prime contractor in its bid. The Bidder's attention is directed to the provisions of Paragraph entitled "Subcontractor Limitations" of the Supplementary General Conditions which stipulates the percent of the WORK to be performed with the Bidder's own forces. Failure to comply with this requirement will render the Bid non-responsive and may cause its rejection.

No.	Work to be Performed	License No.	% of Bid	Subcontractor Name & Address
1				
2				
3				
4				
5				
6				

Attach additional sheets if required.

DOCUMENT 00430

BID BOND (PENAL SUM FORM)

Bidder	**Surety**
Name: Address *(principal place of business):*	Name: Address *(principal place of business):*
Owner Name: South Valley Water Reclamation Facility Address: 7495 South 1300 West, West Jordan Utah 84084	**Bid** Project *(name and location):* MCC Replacement Project, 7495 South 1300 West, West Jordan Utah 84084 Bid Due Date: May 12, 2026
Bond Penal Sum: Date of Bond:	
Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.	

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

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

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.
    3.3. Or Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
5. 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.
6. No suit or action will be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety, and in no case later than 1 year after the Bid due date.
7. Any suit or action under this Bond will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

END OF DOCUMENT

DOCUMENT 00453

BID PREFERENCES

1.01 Do you claim a bid preference in accordance with Utah Procurement Code 63g-6-404 — Preference for Providers of State Products?

[ ]Yes [ ] No

A. If so, are you submitting proof of qualification for bid preference?

[ ]Yes [ ] No

1.02 Do you claim a bid preference in accordance with Utah Procurement Code 63g-6-405 — Preference for Resident Contractors?

[ ]Yes [ ] No

A. If so, are you submitting proof of qualification for bid preference?

[ ]Yes [ ] No

1.03 Did you claim a bid preference in accordance with Utah Procurement Code 63g-6-406 — Preference for Recycled Paper and Paper Products?

[ ]Yes [ ] No

A. If so, are you submitting proof of qualification for bid preference?

[ ]Yes [ ] No

END OF DOCUMENT

SECTION 00500 – AGREEMENT

THIS AGREEMENT is dated as of the _____day of _____ in the year 2026 by and between South Valley Water Reclamation Facility (hereinafter called OWNER) and _____ _____(Hereinafter called CONTRACTOR).

OWNER and CONTRACTOR, in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1. WORK.

CONTRACTOR shall complete the WORK as specified or indicated in the OWNER's Contract Documents entitled "South Valley Water Reclamation Facility – MCC Replacement Project". The WORK is generally described as follows and as listed in Schedule A:

a) The Work consists of replacement of 13 motor control centers with OWNER-procured motor control centers and transfer switches and modification of 1 existing motor control center. Replacement of existing fiber optic cables throughout the site.
b) In addition, the Work includes keeping the OWNER's facility operational using mobile generators and temporary motor control centers as required to comply with the special project constraints.

ARTICLE 2. CONTRACT TIMES

COMPLETION OF WORK: The WORK shall be completed as follows:

1. Contractor shall begin WORK as soon as the Notice to Proceed is issued following award of WORK. Notice to Proceed is planned for May 21, 2026. Work shall be complete by December 15, 2026.

ARTICLE 3. LIQUIDATED DAMAGES

OWNER and the CONTRACTOR recognize that time is of the essence of this Agreement and that the OWNER will suffer financial loss if the WORK is not completed within the time specified in Article 2 herein, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. They also recognize the delays, expense, and difficulties involved in proving in a legal proceeding the actual loss suffered by the OWNER if the WORK is not completed on time. Accordingly, instead of requiring any such proof, the OWNER and the CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) the CONTRACTOR shall pay the OWNER $1000.00 for each day that expires after the deadlines specified in Article 2 herein.

ARTICLE 4. CONTRACT PRICE

OWNER shall pay CONTRACTOR for completion of the WORK in accordance with the Contract Documents in current funds the amount set forth in the Bid Schedule(s).

ARTICLE 5. PAYMENT PROCEDURES

CONTRACTOR shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by OWNER as provided in the General Conditions.

ARTICLE 6. CONTRACT DOCUMENTS

The Contract Documents which comprise the entire agreement between OWNER and CONTRACTOR concerning the WORK consist of this Agreement (pages 00500-1 to 00500-6, inclusive) and the following attachments to this Agreement:

- Notice Inviting Bids (pages 00030-1 to 00030-2, inclusive).
- Instructions to Bidders (pages 00100-1 to 00100-5, inclusive).
- Bid Forms including the Bid, Bid Schedule(s), information required of Bidder, Bid Bond, and all required certificates and affidavits (pages 00300-1 to 00300-9 and 00310-1 to 00310-2, inclusive).
- Performance Bond (pages 00610-1 to 00610-1, inclusive).
- Payment Bond (pages 00620-1 to 00620-1, inclusive).
- General Conditions (pages 00700-1 to 00700-36, inclusive).
- Supplementary General Conditions (pages 00800-1 to 00800-7, inclusive).
- Supplementary General Conditions (Utah) (pages 00810-1 to 00810-4, inclusive).
- Technical Specifications consisting of Divisions and pages, as listed in the Table of Contents.
- Drawings consisting of 152 sheets, as listed in the Table of Contents/List of Drawings.
- Addenda numbers _ to _, inclusive.
- Notice to Proceed.
- Change Orders which may be delivered or issued after Effective Date of this Agreement and are not attached hereto.

There are no Contract Documents other than those listed in this Article 6. The Contract Documents may only be amended by Change Order as provided in Paragraph 3.03 of the General Conditions.

ARTICLE 7. ASSIGNMENTS

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

OWNER and CONTRACTOR each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect of all covenants, agreements and obligations contained in the Contract Documents.

IN WITNESS WHEREOF, OWNER and CONTRACTOR have caused this Agreement to be executed the day and year first above written.

OWNER:
South Valley Water Reclamation Facility
By _____
(Joel Thompson, Board Chairman)

Attest _____

Address for giving notices:
South Valley Water Reclamation Facility
7495 South 1300 West
West Jordan, Utah 84084

Approved as to Form:

_____
(Signature)

_____
(Facility Attorney)

CONTRACTOR:
_____
By_____

[CORPORATE SEAL]

Attest_____

Address for giving notices:
_____
_____
_____

Agent for service of process: _____
_____

Telephone No. for Agent
_____

AGREEMENT CERTIFICATE

(if Corporation)

STATE OF)

) SS:

COUNTY OF)

I HEREBY CERTIFY that a meeting of the Board of Directors of the _____

_____

_____

a corporation existing under the laws of the State of _____, held on _____, 20 _____, the following resolution was duly passed and adopted:

"RESOLVED, that _____, as _____ of this Corporation, be and is hereby authorized to execute the Agreement dated _____, 20___, to the South Valley Water Reclamation Facility by this Corporation and that his/her execution thereof, attested by the Secretary of this Corporation, and with the Corporate Seal affixed, shall be the official act and deed of this Corporation."

I further certify that said resolution is now in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the corporation this _____, day of _____, 20___.

_____

Secretary

(SEAL)

AGREEMENT CERTIFICATE

(if Partnership)

STATE OF)

) SS:

COUNTY OF)

I HEREBY CERTIFY that a meeting of the Partners of the _____

_____

_____

a partnership existing under the laws of the State of _____, held on _____, 20 _____, the following resolution was duly passed and adopted:

"RESOLVED, that _____, as _____ of the Partnership, be and is hereby authorized to execute the Agreement dated_____, 20___, by and between this Partnership and South Valley Water Reclamation Facility by this Partnership and that his/her execution thereof, attested by the _____ shall be the official act and deed of this Partnership."

I further certify that said resolution is now in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand this _____, day of _____, 20___.

_____

AGREEMENT CERTIFICATE

(if Joint Venture)

STATE OF)

) SS:

COUNTY OF)

I HEREBY CERTIFY that a meeting of the Principals of the _____

_____

_____
a joint venture existing under the laws of the State of _____, held on _____, 20 _____, the following resolution was duly passed and adopted:

"RESOLVED, that _____, as _____of the Joint Venture, be and is hereby authorized to execute the Agreement dated_____, 20___, by and between this Joint Venture and South Valley Water Reclamation Facility and that his/her execution thereof, attested by the _____ shall be the official act and deed of this Joint Venture."

I further certify that said resolution is now in full force and effect.

IN WITNESS WHEREOF, I have hereunto set my hand this _____, day of _____, 20___.

_____

SECTION 00510 - PROCUREMENT CONTRACT ASSIGNMENT

FOR VALUE RECEIVED, SOUTH VALLEY WATER RECLAMATION FACILITY, Assignor, hereby assigns, transfers and sets over to _____(Contractor)_____, of _____(Address)_____, Assignee, all of Assignor's right, title and interest in and to the following described procurement contract (copies of which are attached hereto and incorporated by reference as though fully set forth herein), subject to the terms and conditions thereof, to wit:

Description	Amount	Company
OWNER-procured MCC Equipment	$1,075,000	Codale

THIS ASSIGNMENT IS MADE pursuant to and in accordance with terms of the Contract Documents and Specifications entered into by and between Assignor and Assignee for the construction of South Valley Water Reclamation Facility's MCC Replacement Project dated the____ day of _____, 2026.

ASSIGNOR HEREBY DELEGATES to Assignee, upon execution hereof, hereby expressly assumes all of the obligations and duties to be performed by Assignor under the aforesaid Purchase Orders in accordance with the terms thereof and as provided in said Contract Documents and Specifications.

IN WITNESS WHEREOF, Assignor has executed this Assignment this _____ day of _____, 2026.

ASSIGNOR: SOUTH VALLEY WATER RECLAMATION FACILITY

By:_____

Title:_____

Attest:_____

Title:_____

_____(Contractor)_____, Assignee, on this _____ day of _____, 2026, hereby accepts the assignment of the above-described Purchase Orders, subject to the terms and conditions thereof and in accordance with the terms of this Assignment.

ASSIGNEE:

By:_____

Title:_____

DOCUMENT 00515

NOTICE OF AWARD

Date of Issuance:

Owner: South Valley Water Reclamation Facility — Owner's Project No.:

Engineer: Carollo Engineers — Engineer's Project No.: 202633

Project: MCC Replacement Project

Contract Name:

Bidder:

Bidder's Address:

You are notified that Owner has accepted your Bid dated May 12, 2026 for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

Replacing existing motor control centers

The Contract Price of the awarded Contract is $**[Contract Price]**. Contract Price is subject to adjustment based on the provisions of the Contract.

[Number of copies sent] 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 **[number of copies sent]** counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any): **[Describe other conditions that require Successful Bidder's compliance]**

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: South Valley Water Reclamation Facility

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

Copy: Engineer

END OF DOCUMENT

DOCUMENT 00550

NOTICE TO PROCEED

Owner:	South Valley Water Reclamation Facility	Owner's Project No.:	
Engineer:	Carollo Engineers	Engineer's Project No.:	202633
Contractor:		Contractor's Project No.:	
Project:	MCC Replacement Project		
Contract Name:			
Effective Date of Contract:			

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

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

In accordance with the Agreement:

The number of days to achieve Substantial Completion is **[number of days, from Agreement]** from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of **[date, calculated from commencement date above]**; and the number of days to achieve readiness for final payment is **[number of days, from Agreement]** from the commencement date of the Contract Times, resulting in a date for readiness for final payment of **[date, calculated from commencement date above]**.

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

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

Owner: South Valley Water Reclamation Facility

By *(signature)*: _____

Name _____

Title: _____

Date Issued: _____

Copy: Engineer

END OF DOCUMENT

DOCUMENT 00602

ESCROW AGREEMENT FOR SECURITY DEPOSITS IN LIEU OF RETENTION - UT

This escrow agreement is made and entered into by and between _____ whose address is _____ hereinafter called “Owner,” _____ whose address is _____ hereinafter called “Contractor,” and _____ whose address is _____ hereinafter called “Escrow Agent.”

For the consideration hereinafter set forth, Owner, Contractor, and Escrow Agent agree as follows:

1. In accordance with Utah Code, Annotated Section 13-8-5, the Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by Owner pursuant to the construction contract entered into between Owner and Contractor for **[ ]** in the amount of **[ ]** dated **[ ]** (hereafter referred to as the "contract"). Alternatively, on written request of Contractor, Owner shall make payments of the retention earnings directly to Escrow Agent. When Contractor deposits the securities as a substitute for the contract earnings, Escrow Agent shall notify Owner within 10 days of the deposit. The market value of the securities at the time of the substitution shall be at least equal to the cash amount then required to be withheld as retention under the terms of the contract between Owner and Contractor. Securities shall be held in the name of the **[ ]** and shall designate Contractor as the beneficial owner.
2. Owner shall make progress payments to Contractor for those funds which otherwise would be withheld from progress payments pursuant to the contract provision, provided that Escrow Agent holds securities in the form and amount specified above.
3. When Owner makes payment of retentions earned directly to Escrow Agent, Escrow Agent shall hold them for the benefit of Contractor until such time as the escrow created under this contract is terminated. Contractor may direct the investment of the payments into securities. All terms and conditions of this Agreement and the rights and responsibilities of the parties shall be equally applicable and binding when Owner pays Escrow Agent directly.
4. Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the escrow account. These expenses and payment terms shall be determined by the Contractor and Escrow Agent.
5. The interest earned on the securities or the money market accounts held in escrow and all interest earned on the interest shall be for the sole account of Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to Owner.
6. Contractor shall have the right to withdraw all or any part of the principal in the escrow account only by written notice to the Escrow Agent accompanied by written authorization from Owner to the Escrow Agent that Owner consents to the withdrawal of the amount sought to be withdrawn by Contractor.
7. Owner shall have a right to draw upon the securities in the event of default by Contractor. Upon 7 days' written notice to the Escrow Agent from Owner of the default, Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by Owner.

8. Upon receipt of written notification from Owner certifying that the contract is final and complete, and that Contractor has complied with all requirements and procedures applicable to the contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the escrow account. The escrow shall be closed immediately upon disbursement of all moneys and securities on deposit and payments of fees and charges.
9. Escrow Agent shall rely on the written notifications from Owner and Contractor pursuant to Sections above, inclusive, of this Agreement and Owner and Contractor shall hold the Escrow Agent harmless from the Escrow Agent's release, conversion, and disbursement of the securities and interest as set forth above.
10. The names of the persons who are authorized to give written notice or to receive written notice on behalf of Owner and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures are as follows:

On behalf of Owner:	On behalf of Contractor:
Title	Title
Name	Name
Signature	Signature
Address 7495 South 1300 West, West Jordan Utah 84084	Address

On behalf of the Escrow Agent:

Title

Name

Signature

Address

At the time the escrow account is opened, Owner and Contractor shall deliver to the Escrow Agent a fully executed counterpart of this Agreement.

END OF DOCUMENT

DOCUMENT 00609

SURETY'S AGREEMENT TO ASSIGNMENT

Surety hereby acknowledges, agrees, and consents that the Procurement Contract for furnishing Goods and Special Services entitled MCC Replacement Project by and between South Valley Water Reclamation Facility ("Buyer") and Codale Electric Supply ("Seller") may be assigned, transferred, and set over to **[Name of Contractor/Assignee]** ("Contractor/Assignee"), in accordance with Article 5 and Exhibit A of the Agreement between Buyer and Seller for Procurement Contract.

Surety further agrees that, upon assignment of the Procurement Contract, the Contractor/Assignee shall have all the rights of the Buyer under the Procurement Performance Bond and Procurement Payment Bond.

Agreement to Assignment Acknowledged and Accepted by Surety

_____
(typed or printed name of organization)

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

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

Attach Power of Attorney.

END OF DOCUMENT

SECTION 00610 - PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____ as CONTRACTOR,

and _____ as Surety,

are held and firmly bound unto South Valley Water Reclamation Facility hereinafter called "OWNER," in the sum of _____ dollars,

for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH that said CONTRACTOR has been awarded and is about to enter into the annexed Agreement with said OWNER to perform the WORK as specified or indicated in the Contract Documents entitled “South Valley Water Reclamation Facility – MCC Replacement Project”.

NOW THEREFORE, if said CONTRACTOR shall perform all the requirements of said Contract Documents required to be performed on its part, at the times and in the manner specified therein, then this obligation shall be null and void, otherwise it shall remain in full force and effect.

PROVIDED, that any alterations in the WORK to be done or the materials to be furnished, or changes in the time of completion, which may be made pursuant to the terms of said Contract Documents, shall not in any way release said CONTRACTOR or said Surety hereunder, nor shall any extensions of time granted under the provisions of said Contract Documents, release either said CONTRACTOR or said Surety, and notice of such alterations or extensions of the Agreement is hereby waived by said Surety.

IN WITNESS WHEREOF, we have hereunder set our hands this_____day of_____, 20___.

(SEAL)	(SEAL)
_____	_____
(CONTRACTOR)	(Surety)
By: _____	By:_____
(Signature and SEAL)	(Signature and SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

DOCUMENT 00612

WARRANTY BOND

Contractor	**Surety**
Name: **[Full formal name of Contractor]** Address *(principal place of business)*: **[Address of Contractor's principal place of business]**	Name: **[Full formal name of Surety]** Address *(principal place of business)*: **[Insert address of Surety's principal place of business]**
Owner Name: South Valley Water Reclamation Facility Address *(principal place of business)*: 7495 South 1300 West, West Jordan, Utah 84084	**Construction Contract** Description *(name and location)*: **[Owner's project/contract name, and location of the project]** Contract Price: **[Amount from Contract]** Effective Date of Contract: **[Date from Contract]** Contract's Date of Substantial Completion: **[Date from Contract]**
Bond Bond Amount: **[Amount]** Date of Bond: **[Date]** Modifications to this Bond form: ☐ None ☐ See Paragraph 9	Bond Period: Commencing 364 days after Substantial Completion of the Work under the Construction Contract, and continuing until **[insert number of years, typically either 2 or 3]** years after such Substantial Completion.

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

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

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

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract's Correction Period Obligations. The Construction Contract is incorporated in this Document by reference.
2. If the Contractor performs the Correction Period Obligations, the Surety and the Contractor shall have no obligation under this Warranty Bond.
3. If Owner gives written notice to Contractor and Surety during the Bond Period of Contractor's obligation under the Correction Period Obligations, and Contractor does not fulfill such obligation, then Surety shall be responsible for fulfillment of such Correction Period Obligations. Surety shall either fulfill the Correction Period Obligations itself, through its agents or contractors, or, in the alternative, Surety may waive the right to fulfill the Correction Period Obligations itself, and reimburse the Owner for all resulting costs incurred by Owner in performing Contractor's Correction Period Obligations, including but not limited to correction, removal, replacement, and repair costs.
4. The Surety's liability is limited to the amount of this Warranty Bond. Renewal or continuation of the Warranty Bond will not modify such amount, unless expressly agreed to by Surety in writing.
5. The Surety shall have no liability under this Warranty Bond for obligations of the Contractor that are unrelated to the Construction Contract. No right of action will accrue on this Warranty Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.
6. Any proceeding, legal or equitable, under this Warranty Bond may be instituted in any court of competent jurisdiction in the location in which the Work or part of the Work is located and must be instituted within 2 years after the Surety refuses or fails to perform its obligations under this Warranty Bond.
7. Written notice to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown in this Warranty Bond.
8. Definitions:
    8.1. Construction Contract—The agreement between the Owner and Contractor identified on the cover page of this Warranty Bond, including all Contract Documents and changes made to the agreement and the Contract Documents.
    8.2. Contract Documents—All the documents that comprise the agreement between the Owner and Contractor.
    8.3. Correction Period Obligations—The duties, responsibilities, commitments, and obligations of the Contractor with respect to correction or replacement of defective Work, as set forth in the Construction Contract's Correction Period clause, Document 00700 - General Conditions , Paragraph 15.08, as duly modified.
    8.4. Substantial Completion—As defined in the Construction Contract.
    8.5. Work—As defined in the Construction Contract.
9. Modifications to this Bond are as follows: None.

END OF DOCUMENT

SECTON 00620 – PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____ as CONTRACTOR,

and _____ as Surety,

are held and firmly bound unto South Valley Water Reclamation Facility hereinafter called "OWNER," in the sum of _____ dollars, for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

THE CONDITIONS OF THIS OBLIGATION ARE SUCH that said CONTRACTOR has been awarded and is about to enter into the annexed Agreement with said OWNER to perform the WORK as specified or indicated in the Contract Documents entitled “MCC Replacement Project”.

NOW THEREFORE, if said CONTRACTOR, or subcontractor, fails to pay for any materials, equipment, or other supplies, or for rental of same, used in connection with the performance of work contracted to be done, or for amounts due under applicable State law for any work or labor thereon, said Surety will pay for the same in an amount not exceeding the sum specified above, and, in the event suit is brought upon this bond, reasonable attorney’s fees to be fixed by the court. This bond shall inure to the benefit of any persons, companies, or corporations entitled to file claims under applicable State law so as to give a right of action to them or their assigns in any suit brought upon this bond.

PROVIDED, that any alterations in the WORK to be done or the materials to be furnished, or changes in the time of completion, which may be made pursuant to the terms of said Contract Documents, shall not in any way release said CONTRACTOR or said Surety thereunder, nor shall any extensions of time granted under the provisions of said Contract Documents release either said CONTRACTOR or said Surety, and notice of such alterations or extensions of the Agreement is hereby waived by said Surety.

IN WITNESS WHEREOF, we have hereunto set our hands and seals this_____ day of _____, 20____.

_____(SEAL) _____(SEAL)
(CONTRACTOR) (Surety)

By: _____ By: _____
(Signature) (Signature and SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

- END OF BID FORMS -

Document 00622
Contractor's Application for Payment

Owner:	South Valley Water Reclamation Facility		**Contractor's Application for Payment No.**
Owner's Contract No.:			**Application Period:**
Contractor:		Contractor's Project No.:	**Application Date:**
Project Name:	MCC Replacement Project		
Contract Name:			
Engineer:	Carollo Engineers	Engineer's Project No: 202633	

Application for Payment

Change Order Summary

Approved Change Orders

Number	Additions	Deductions
TOTALS	$0.00	$0.00
NET CHANGE BY CHANGE ORDERS	**$0.00**	

1. ORIGINAL CONTRACT PRICE				$
2. Net change by Change Orders				$ **$0.00**
3. Current Contract Price (Line 1 ± 2)				$ **$0.00**
4. TOTAL COMPLETED AND STORED TO DATE				
(Column F total on Progress Estimates)				$ **$0.00**
5. RETAINAGE:				
a.	**X**	$0.00	**Work Completed**	$ **$0.00**
b. 0%	**X**	$0.00	**Stored Material**	$ **$0.00**
c. Total Retainage (Line 5.a + Line 5.b)				$ **$0.00**
6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c)				$ **$0.00**
7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)				$
8. AMOUNT DUE THIS APPLICATION				$ **$0.00**
9. BALANCE TO FINISH, PLUS RETAINAGE				$
(Column G total on Progress Estimates + Line 5.c above)				$ **$0.00**

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:
(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;

(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and

(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor Signature

By:	Date:

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is recommended by: _____ _____
(Engineer) (Date)

Payment of: $ _____
(Line 8 or other - attach explanation of the other amount)

is approved by: _____ _____
(Owner) (Date)

Approved by: _____ _____
Funding or Financing Entity (if applicable) (Date)

Document 00622
Contractor's Application for Payment

Owner:	South Valley Water Reclamation Facility		**Contractor's Application for Payment No.**
Owner's Contract No.:			**Application Period:**
Contractor:		Contractor's Project No.:	**Application Date:**
Project Name:	MCC Replacement Project		
Contract Name:			
Engineer:		Engineer's Project No:	

Progress Estimate - Lump Sum Work

			Work Completed		E	F		G
A		B	C	D	Materials Presently Stored (not in C or D)	Total Completed and Stored to Date (C + D + E)	% (F / B)	Balance to Finish (B - F)
Specification Section No.	Description	Scheduled Value ($)	From Previous Application (C+D)	This Period				
			$0.00			$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
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						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
						$0.00		$0.00
	Totals	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**		**$0.00**

Document 00622
Contractor's Application for Payment

Owner:	South Valley Water Reclamation Facility		**Contractor's Application for Payment No.**
Owner's Contract No.:			**Application Period:**
Contractor:		Contractor's Project No.:	**Application Date:**
Project Name:	MCC Replacement Project		
Contract Name:			
Engineer:		Engineer's Project No:	

Progress Estimate - Unit Price Work

A					B	C	D	E	F		
Item		Contract Information									
Bid Item No.	Description	Item Quantity	Units	Unit Price	Total Value of Item ($)	Estimated Quantity Installed	Value of Work Installed to Date	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F / B)	Balance to Finish (B - F)
							$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
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					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
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					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
					$0.00		$0.00		$0.00		$0.00
	Totals				**$0.00**		**$0.00**	**$0.00**	**$0.00**		**$0.00**

Document 00622
Contractor's Application for Payment

Owner: South Valley Water Reclamation Facility		**Contractor's Application for Payment No.**
Owner's Contract No.:		**Application Period:**
Contractor:	Contractor's Project No.:	**Application Date:**
Project MCC Replacement Project		
Contract Name:		
Engineer:	Engineer's Project No:	

Progress Estimate - Stored Material Summary

A		B	C		D		E		F		G
					Stored Previously				Incorporated in Work		
Bid Item No.	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Storage Location	Description of Materials or Equipment Stored	Date Placed into Storage (Month/Year)	Amount ($)	Amount Stored this Month ($)	Subtotal Amount Completed and Stored to Date (D + E)	Date (Month/ Year)	Amount ($)	Materials Remaining in Storage ($) (D + E - F)
								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
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								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
								$0.00			$0.00
				Totals		**$0.00**	**$0.00**	**$0.00**		**$0.00**	$0.00

DOCUMENT 00625

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	South Valley Water Reclamation Facility	Owner's Project No.:	
Engineer:	Carollo Engineers, Inc.	Engineer's Project No.:	202633
Contractor:		Contractor's Project No.:	
Project: Contract Name:			

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

[Describe the portion of the work for which Certificate of Substantial Completion is issued]

Date of Substantial Completion: **[Enter date, as determined by Engineer]**

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

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

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

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

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

[List amendments to Owner's Responsibilities]

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

[List amendments to Contractor's Responsibilities]

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

[List attachments such as punch list; other documents]

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

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00632

REQUEST FOR INFORMATION OR INTERPRETATION (RFI)

Owner:	South Valley Water Reclamation Facility	**Date:**	XX/XX/XXXX
Contractor:	Click here to enter text.	**Project No.:**	00000.00
Project Name:	MCC Replacement Project	**RFI No.:**	000
RFI Title:	Click here to enter text.	**Spec/Dwg. Reference:**	00000

Information or Interpretation and Reason Requested			
Click here to enter text.			
Authored By:	Click here to enter text.	**Date Submitted:**	XX/XX/XXXX

Response to Request:			
Click here to enter text.			
In the event, Contractor believes the RFI response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.			
Firm Name:	Click here to enter text.	**Date Returned:**	XX/XX/XXXX
Signature:		**Printed Name:**	

END OF DOCUMENT

SECTION 00700
GENERAL CONDITIONS

ARTICLE 1 – DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents and printed with initial or all capital letters, the following terms have the meanings indicated:

Addenda – Written or graphic instruments issued prior to the opening of Bids which make additions, deletions, or revisions to the Contract Documents.

Agreement – The written contract between the OWNER and the CONTRACTOR for the performance of the WORK pursuant to the Contract Documents. Documents incorporated into the contract by reference become part of the contract and of the Agreement.

Application for Payment – The form furnished by the ENGINEER and completed by the CONTRACTOR to request progress or final payment including supporting documentation to substantiate the amounts for which payment is requested.

Bid – The offer or proposal of a Bidder, submitted on the prescribed form, setting forth the price or prices for the WORK to be performed.

Bidder – Any person, firm or corporation submitting a Bid for the WORK.

Bonds – Bid, Performance and Payment Bonds and other instruments which protect the OWNER against loss due to inability or refusal of the CONTRACTOR to perform pursuant to the Contract Documents.

Change Order – A document recommended by the OWNER'S REPRESENTATIVE, which is signed by the CONTRACTOR and the OWNER and authorizes an addition, deletion, or revision in the WORK, or an adjustment in the Contract Price or the Contract Time, issued on or after the Effective Date of the Agreement.

Contract Documents – The documents which comprise the entire agreement between OWNER and CONTRACTOR concerning the WORK, consisting of the Drawings, Technical Specifications, General Conditions, Supplementary General Conditions, Notice Inviting Bids, Instructions to Bidders, Addenda, CONTRACTOR's Bid, Information Required of Bidder, Agreement, Performance Bond, Payment Bond, Notice To Proceed and Change Orders. Only printed or hard copies of the documents listed above are Contract Documents.

Contract Price – The total monies payable by the OWNER to the CONTRACTOR for completion of the WORK under the terms and conditions of the Contract Documents.

Contract Time – The number of successive Days or the date stated in the Contract Documents for Substantial Completion of the WORK. The Contract Time begins to run on the date specified in the Notice to Proceed.

CONTRACTOR – The person, firm, or corporation with whom the OWNER has executed the Agreement.

Day – A calendar day of 24 hours measured from midnight to the next midnight.

Defective Work – Work that: is unsatisfactory, faulty, or deficient; does not conform to the Contract Documents; does not meet the requirements of any inspection, reference standard, test, or approval referred to in the Contract Documents; has been damaged prior to the ENGINEER's recommendation of final payment.

Drawings – The drawings, plans, maps, profiles, diagrams, and other graphic representations which show the character, location, nature, extent, and scope of the WORK.

Effective Date of the Agreement – The date indicated in the Agreement on which it was executed.

ENGINEER – The person, firm or corporation named as such in the Contract Documents.

Field Order – A written order issued by the OWNER which requires minor changes in the WORK, but which does not involve a change in the Contract Price or Contract Time.

General Requirements – Division 1 of the Technical Specifications.

Laws and Regulations; Laws or Regulations – Includes any and all applicable state, federal and local statutes, common law, rules, regulations, ordinances, codes, and/or orders.

Notice of Award – The OWNER's written notice to the apparent successful Bidder stating that upon compliance with the conditions precedent enumerated therein by the apparent successful Bidder within the time specified, the OWNER will enter into the Agreement.

Notice to Proceed – The OWNER's written notice to the CONTRACTOR authorizing the CONTRACTOR to proceed with the work and establishing the date of commencement of the Contract Time.

OWNER – SOUTH VALLEY WATER RECLAMATION FACILITY.

OWNER'S REPRESENTATIVE – The authorized representative of the OWNER who is assigned to the site or any part thereof.

Partial Utilization – Placing a portion of the WORK in service for the purpose for which it is intended (or a related purpose) before reaching Substantial Completion of the WORK.

Project – A unit of total construction of which the WORK to be provided under the Contract Documents, may be the whole, or a part thereof.

Shop Drawings – All drawings, diagrams, illustrations, schedules and other data which are specifically prepared by or for the CONTRACTOR to illustrate some portion of WORK and all illustrations, brochures, standard schedules, performance charts, instruction, and diagrams to illustrate material or equipment for some portion of the WORK.

Specifications – (Same definition as for Technical Specifications hereinafter).

Subcontractor – An individual, firm, or corporation having a direct contract with the CONTRACTOR or with any other Subcontractor for the performance of a part of the WORK.

Substantial Completion – That state of construction when the WORK has progressed to the point where, in the opinion of the OWNER as evidenced by the Notice of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the WORK can be

utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to any work refer to substantial completion thereof.

Supplementary General Conditions – The part of the Contract Documents which makes additions, deletions, or revisions to these General Conditions.

Supplier – A manufacturer, fabricator, supplier, distributor, materialman, or vendor.

Technical Data – The factual information contained in reports describing physical conditions, including: exploration method, plans, logs, laboratory test methods and factual data. Technical Data does not include conclusions, interpretations, interpolations, extrapolations or opinions contained in reports or reached by the CONTRACTOR.

Technical Specifications – Those portions of the Contact Documents consisting of the General Requirements and written technical descriptions of products and execution of the WORK.

Underground Utilities – All pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments and any encasements containing such facilities which have been installed underground to furnish any of the following services or materials: water, sewage and drainage removal, electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, traffic, or other control systems.

WORK – The entire construction required to be furnished under the Contract Documents. WORK is the result of performing services, furnishing labor and supervision, and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 DELIVERY OF BONDS/INSURANCE CERTIFICATES

A. The CONTRACTOR shall deliver to the OWNER the Bonds and insurance certificates required by the Contract Documents within ten (10) days after receiving the Notice of Award from the OWNER.

2.02 COPIES OF DOCUMENTS

A. The OWNER shall furnish the CONTRACTOR five copies of the Contract Documents (Specifications and reduced Drawings), together with two sets of full-scale Drawings. Additional quantities of the Contract Documents will be furnished at reproduction cost.

2.03 STARTING THE PROJECT

A. The CONTRACTOR shall begin construction of the WORK within 10 days after the commencement date stated in the Notice to Proceed, but shall not commence construction prior to the commencement date.

2.04 BEFORE STARTING CONSTRUCTION

A. Before undertaking each part of the WORK, the CONTRACTOR shall carefully study and compare the Contract Documents to check and verify pertinent figures and dimensions shown thereon with all applicable field measurements. The CONTRACTOR shall promptly report in writing to the OWNER any conflict, error, or discrepancy which the CONTRACTOR may discover and shall obtain a written interpretation or clarification from the OWNER before proceeding with any work affected thereby.

B. The CONTRACTOR shall submit to the OWNER for review those documents called for under the Section entitled “Contractor Submittals” in the General Requirements.

2.05 PRECONSTRUCTION CONFERENCE

A. The CONTRACTOR shall attend a preconstruction conference with the OWNER, the ENGINEER and others as appropriate to discuss the construction of the WORK in accordance with the Contract Documents.

2.06 FINALIZING SCHEDULES

A. At least 7 days before the CONTRACTOR's submittal of its first Application for Payment, the CONTRACTOR, the OWNER, and others as appropriate will meet to finalize the schedules submitted in accordance with the General Requirements.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 INTENT

A. The Contract Documents comprise the entire agreement between OWNER and CONTRACTOR concerning the WORK. The Contract Documents are complementary, what is called for by one is as binding as if called for by all. The Contract Documents will be construed in accordance with the law of the place of the Project.

B. It is the intent of the Contract Documents to describe the WORK, as completely as possible and in a functional manner. The WORK is intended to be constructed in accordance with the Contract Documents. All work, materials, or equipment that may be reasonably inferred from the Contract Documents as being required to produce the completed work shall be supplied whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe work, materials, or equipment such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals, or codes or any technical society, organization, or association, or to the Laws or Regulations of any governmental authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids, except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual, or code (whether or not specifically incorporated by reference in the Contract Documents) shall be effective to change the duties and responsibilities of the OWNER, the CONTRACTOR, or the ENGINEER or any of their consultants, agents, or employees from those set forth in the Contract Documents.

C. If, during the performance of the WORK, the CONTRACTOR finds a conflict, error or discrepancy in the Contract Documents, the CONTRACTOR shall immediately report it to the OWNER in writing and before proceeding with the work affected thereby. The OWNER shall then make a written interpretation, clarification, or correction.

3.02 ORDER OF PRECEDENCE OF CONTRACT DOCUMENTS

A. In resolving issues resulting from conflicts, errors, or discrepancies in any of the Contract Documents, or the order of precedence shall be as follows:

1. Change Orders
2. Agreement
3. Addenda
4. Supplementary General Conditions
5. General Conditions
6. Technical Specifications
7. Referenced Standard Specifications
8. Drawings
9. Contractor's Bid (Bid Form).

B. With reference to the Drawings the order of precedence is as follows:

1. Figures govern over scaled dimensions
2. Detail drawings govern over general drawings
3. Addenda/change order drawings govern over general drawings

4. Contract Drawings govern over standard drawings.

3.03 AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

A. The Contract Documents may be amended by a Change Order (pursuant to Article 10) to provide for additions, deletions or revisions in the WORK or to modify terms and conditions.

3.04 REUSE OF DOCUMENTS

A. Neither the CONTRACTOR, Subcontractor, Supplier, nor any other person or organization performing any of the WORK under a contract with the OWNER shall have or acquire any title to or ownership rights in any of the Drawings, Technical Specifications, or other documents used on the WORK, and they shall not reuse any of them on the extensions of the Project or any other project without the written consent of the OWNER and the ENGINEER.

ARTICLE 4 – AVAILABILITY OF LANDS: PHYSICAL CONDITIONS, REFERENCE POINTS

4.01 AVAILABILITY OF LANDS

A. The OWNER shall furnish the lands, rights-of-way and easements upon which the WORK is to be performed and for access thereto, together with other lands designated for the use of the CONTRACTOR in the Contract Documents. Easements for permanent structures or permanent changes in existing major facilities will be obtained and paid for by the OWNER, unless otherwise provided in the Contract Documents. Nothing contained in the Contract Documents shall be interpreted as giving the CONTRACTOR exclusive occupancy of the lands or rights-of-way provided. The CONTRACTOR shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment. The CONTRACTOR shall not enter upon nor use any property not under the control of the OWNER until a written temporary construction easement agreement has been executed by the CONTRACTOR and the property owner, and a copy of the easement furnished to the ENGINEER prior to its use. Neither the OWNER nor the ENGINEER shall be liable for any claims or damages resulting from the CONTRACTOR's unauthorized trespass or use of any properties.

4.02 PHYSICAL CONDITIONS – SUBSURFACE AND EXISTING STRUCTURES

A. Explorations and Reports: The Supplementary General Conditions may identify exploration reports and subsurface conditions tests at the site that have been utilized by the OWNER in the preparation of the Contract Documents. The CONTRACTOR may rely upon the accuracy of the Technical Data contained in these reports. The CONTRACTOR is responsible for the interpretation, extrapolation or interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.

B. Existing Structures: The Supplementary General Conditions identify the drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Utilities referred to in Paragraph 4.04 herein) which are at or contiguous to the site that have been utilized by the OWNER in the preparation of the Contract Documents. The CONTRACTOR is responsible for the interpretation, extrapolation or

interpolation of all technical as well as nontechnical data and its reliance on the completeness, opinions and interpretation of the reports.

4.03 DIFFERING SITE CONDITIONS

A. The CONTRACTOR shall notify the OWNER upon encountering any of the following unforeseen conditions, hereinafter called "differing site conditions," during the prosecution of the WORK. The CONTRACTOR's notice to the OWNER shall be in writing and delivered before the differing site conditions are disturbed, but in no event later than 14 days after their discovery.

1. Subsurface or latent physical conditions at the site of the WORK which could not reasonably have been discovered through diligent inspection by CONTRACTOR before his Bid was submitted which differs materially from those indicated, described, or delineated in the Contract Documents including those reports and documents discussed in Paragraph 4.02; and

2. Physical conditions at the site of the WORK of an unusual nature which could not reasonably have been discovered through diligent inspection by CONTRACTOR before his Bid was submitted and which differ materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents including those reports and documents discussed in Paragraph 4.02.

B. The OWNER will review the alleged differing site conditions; determine the necessity of obtaining additional explorations or tests with respect to verifying their existence and extent.

C. If the OWNER concludes that because of newly discovered conditions a change in the Contract Documents is required, a Change Order will be issued as provided in Article 10 to reflect and document the consequences of the differing site conditions.

D. In each such case, an increase or decrease in the Contract Price or an extension or shortening of the Contract Time, or any combination thereof, will be allowable to the extent that they are attributable to the differing site conditions. If the OWNER and the CONTRACTOR are unable to agree as to the amount or length of the Change Order, a claim may be made as provided in Articles 11 and 12.

E. The CONTRACTOR's failure to give written notice of differing site conditions within 14 days of their discovery and before they are disturbed shall constitute a waiver of all claims in connection therewith, whether direct or consequential in nature.

4.04 PHYSICAL CONDITIONS – UNDERGROUND UTILITIES

A. Shown or Indicated: The information and data shown or indicated in the Contract Documents with respect to existing Underground Utilities at or contiguous to the site are based on information and data furnished to the OWNER by the owners of Underground Utilities or by others. Unless it is expressly provided in the Supplementary General Conditions, the OWNER and the ENGINEER shall not be responsible for the accuracy or completeness of any Underground Utilities information or data. The CONTRACTOR's responsibility relating to underground utilities are: review and check all information and

data, locate all Underground Utilities shown or indicated in the Contract Documents, coordinate the WORK with the owners of Underground Utilities during construction, safeguard and protect the Underground Utilities, and repair any damage to Underground Utilities resulting from the WORK. The cost of all these activities will be considered as having been included in the Contract Price.

B. Not Shown or Indicated: If an Underground Utility not shown or indicated in the Contract Documents is uncovered or revealed at or contiguous to the site and which the CONTRACTOR could not reasonably have been expected to be aware of, the CONTRACTOR shall identify the owner of the Underground Utility, give written notice of the location to that owner and notify the OWNER.

4.05 REFERENCE POINTS

A. The OWNER will provide one bench mark, near or on the site of the WORK, and will provide two points near or on the site to establish a base line for use by the CONTRACTOR in laying out the WORK. Unless otherwise specified in the General Requirements, the CONTRACTOR shall furnish all other lines, grades, and bench marks required for proper execution of the WORK.

B. The CONTRACTOR shall preserve all bench marks, stakes, and other survey marks. In case of their removal or destruction by its own employees or by its subcontractor's employees, the CONTRACTOR shall be responsible for the accurate replacement of reference points by professionally qualified personnel at no additional cost to the OWNER.

ARTICLE 5 – BONDS AND INSURANCE

5.01 PERFORMANCE, PAYMENT AND OTHER BONDS

A. The CONTRACTOR shall furnish Performance and Payment Bonds, each in the amount of 100% of the Contract Price as security for the faithful performance and payment of all the CONTRACTOR's obligations under the Contract Documents. The Performance Bond shall remain in effect at least until one year after the date of Notice of Completion, except as otherwise provided by Law or Regulation or by the Contract Documents. After the OWNER issues the Notice of Completion, the amount of the Performance Bond may be reduced to 10 percent of the Contract Price, or $1,000, whichever is greater. The CONTRACTOR shall also furnish such other Bonds as are required by the Supplementary General Conditions. The OWNER, at its sole discretion, may waive bond requirements for work not exceeding $50,000.

B. If the surety on any Bond furnished by the CONTRACTOR is declared a bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the WORK is located, the CONTRACTOR shall within 7 days after written approval by the OWNER of a substitute Bond and Surety substitute the approved Bond and Surety.

5.02 INSURANCE

A. The CONTRACTOR shall purchase and maintain the insurance required under this paragraph. This insurance shall include the specific coverages set out herein and be written for not less than the limits of liability and coverages provided in the Supplementary General Conditions, or required by law, whichever is greater. The CONTRACTOR's

liabilities under the Agreement shall not be deemed limited in any way to the insurance coverage required.

B. The CONTRACTOR shall furnish the OWNER with certificates indicating the type, amount, class of operations covered, effective dates and expiration dates of all policies. All insurance policies purchased and maintained (or the certificates or other evidence thereof) shall contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 30 days' prior written notice has been given to the OWNER by certified mail. Contract or certificate terms which state that reasonable efforts will be made to notify the OWNER prior to cancellation, change or renewal of the policy are not acceptable. All insurance shall remain in effect until the OWNER issues the Notice of Final Completion and at all times thereafter when the CONTRACTOR may be correcting, removing, or replacing defective work in accordance with Paragraph 13.01B or completing punch list items required by the Notice of Substantial Completion. In addition, the insurance required herein (except for Worker's Compensation and Employer's Liability) shall name the OWNER, the ENGINEER, and their officers, agents, and employees as "additional insured" under the policies. All liability insurance policies shall be occurrence and not claims made policies.

1. Workers' Compensation and Employer's Liability: This insurance shall protect the CONTRACTOR against all claims under applicable state workers' compensation laws. The CONTRACTOR shall also be protected against claims for injury, disease, or death of employees which, for any reason, may not fall within the provisions of a workers' compensation law. This policy shall include an "all states" endorsement. The CONTRACTOR shall require each subcontractor similarly to provide Workers' Compensation Insurance for all of the latter's employees to be engaged in the WORK unless its employees are covered by the protection afforded by the CONTRACTOR's Workers' Compensation Insurance. In the event a class of employees is not protected under the Workers' Compensation Statute, the CONTRACTOR or Subcontractor, as the case may be, shall provide adequate employer's liability insurance for the protection of its employees not protected under the statute.

2. Comprehensive General Liability: This insurance shall be written in comprehensive form and shall protect the CONTRACTOR against all claims arising from injuries to persons other than its employees and damage to property of the OWNER or others arising out of any act or omission of the CONTRACTOR or its agents, employees or subcontractors. The policy shall include the following endorsements: (1) Protective Liability endorsement to insure the contractual liability assumed by the CONTRACTOR under the indemnification provisions in these General Conditions; (2) Broad Form Property Damage endorsement; (3) Personal Injury endorsement to cover personal injury liability for intangible harm. The Comprehensive General Liability coverage shall contain no exclusion relative to blasting, explosion, collapse of building, or damage to underground structures.

3. Comprehensive Automobile Liability: This insurance shall be written in comprehensive form. The policy shall protect the CONTRACTOR against all claims for injuries to employees, members of the public and damage to property of others arising from the use of CONTRACTOR's motor vehicles, whether they are owned, non-owned, or hired, and whether used or operated on or off the site. The motor vehicle insurance required under this paragraph shall include: (a) motor

vehicle liability coverage; (b) personal injury protection coverage and benefits; (c) uninsured motor vehicle coverage; and (d) underinsured motor vehicle coverage.

4. Subcontractor's Insurance: The CONTRACTOR shall require each of its subcontractors to procure and to maintain Comprehensive General Liability Insurance and Comprehensive Automobile Liability Insurance of the type and in the amounts specified in the Supplementary General Conditions or insure the activities of its subcontractors in the CONTRACTOR's own policy, in like amount.

5. Builder's Risk: This insurance shall be of the "all risk" type, shall be written in completed value form, and shall protect the CONTRACTOR, the OWNER, and the ENGINEER against damage to buildings, structures, materials and equipment. The amount of this insurance shall not be less than the insurable value of the WORK at completion. Builder's risk insurance shall provide for losses to be payable to the CONTRACTOR, the OWNER, and the ENGINEER as their interests may appear. The policy shall contain a provision that in the event of payment for any loss under the coverage provided, the insurance company shall have no rights of recovery against the CONTRACTOR, the OWNER, or the ENGINEER. The Builder's Risk policy shall insure against all risks of direct physical loss or damage to property from any external cause including flood and earthquake. Allowable exclusions, if any, shall be as specified in the Supplementary General Conditions.

ARTICLE 6 – CONTRACTOR RESPONSIBILITIES

6.01 SUPERVISION AND SUPERINTENDENCE

A. The CONTRACTOR shall supervise and direct the WORK competently and efficiently, devoting the attention and applying the skills and expertise necessary to perform the WORK in accordance with the Contract Documents. The CONTRACTOR shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction and safety precautions and programs incidental thereto. The CONTRACTOR shall be responsible to see that the finished WORK complies accurately with the Contract Documents.

B. The CONTRACTOR shall employ the superintendent named in "Information Required of Bidder" on the work site at all times during the progress of the WORK. The superintendent shall not be replaced without the OWNER's written consent. The superintendent will be the CONTRACTOR's representative at the site and shall have authority to act on behalf of the CONTRACTOR. All communications given to the superintendent shall be as binding as if given to the CONTRACTOR. The CONTRACTOR shall issue all its communications to the OWNER.

C. The CONTRACTOR's superintendent, or OWNER approved representative shall be present at the site of the WORK at all times while work is in progress. Failure to observe this requirement shall be considered suspension of the WORK by the CONTRACTOR until the superintendent is again present at the site.

6.02 LABOR, MATERIALS, AND EQUIPMENT

A. The CONTRACTOR shall provide skilled, competent and suitably qualified personnel to survey and lay out the WORK and perform construction as required by the Contract Documents. The CONTRACTOR shall at all times maintain good discipline and order at the site.

B. Except in connection with the safety or protection of persons at the WORK, or property at the site or adjacent thereto, all work at the site shall be performed during regular working hours (7:00 a.m. – 6:00 p.m., Monday through Friday), and the CONTRACTOR will not permit overtime work or the performance of work on Saturday, Sunday or any legal holiday observed by the OWNER without the OWNER's written consent given after prior written notice to the OWNER. Except as otherwise provided in this Paragraph, the CONTRACTOR shall receive no additional compensation for overtime work, i.e., work in excess of 8 hours in any one calendar day or 40 hours in any one calendar week, even though such overtime work may be required under emergency conditions and may be ordered by the OWNER in writing. Additional compensation will be paid the CONTRACTOR for overtime work in the event extra work is ordered by the OWNER and the Change Order specifically authorizes the use of overtime work, but only to the extent that the CONTRACTOR pays overtime wages on a regular basis being paid (>40 hours per week) for overtime work of a similar nature in the same locality.

C. All costs of inspection and testing performed during overtime work approved solely for the convenience of the CONTRACTOR shall be borne by the CONTRACTOR. The OWNER shall have the authority to deduct the costs of all inspection and testing from any partial payments otherwise due to the CONTRACTOR.

D. Unless otherwise specified in the Contract Documents, the CONTRACTOR shall furnish, erect, maintain and remove the construction plant, and temporary works and assume full responsibility for all materials, equipment, labor, transportation, construction equipment, machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities and all other facilities and incidentals necessary for the furnishing, performance testing, start-up and completion of the WORK.

E. All materials and equipment incorporated into the WORK shall be of new and good quality, except as otherwise provided in the Contract Documents. If required by the OWNER, the CONTRACTOR shall furnish satisfactory evidence (including reports of required tests) as to the kind and quality of materials and equipment. The CONTRACTOR shall apply, install, connect, erect, use, clean, and condition all material and equipment in accordance with the instructions of the manufacturer and Supplier except as otherwise provided in the Contract Documents.

6.03 ADJUSTING PROGRESS SCHEDULE

A. The CONTRACTOR shall submit any adjustments in the progress schedule to the OWNER for acceptance in accordance with the provisions for "Contractor Submittals" in the General Requirements.

6.04 SUBSTITUTES AND "OR-EQUAL" ITEMS

A. The CONTRACTOR shall submit proposed substitutes and "or-equal" items in accordance with the provisions for "Contractor Submittals" in the General Requirements.

6.05 SUBCONTRACTORS, SUPPLIERS, AND OTHERS

A. The CONTRACTOR shall be responsible to the OWNER and the ENGINEER for the acts and omissions of its subcontractors and their employees to the same extent as the CONTRACTOR is responsible for the acts and omissions of its own employees. Nothing contained in this paragraph shall create any contractual relationship between any subcontractor and the OWNER or the ENGINEER nor relieve the CONTRACTOR of any liability or obligation under the Agreement.

6.06 PERMITS

A. Unless otherwise provided in the Supplementary General Conditions, the CONTRACTOR shall obtain and pay for all construction permits and licenses from the agencies having jurisdiction, including furnishing the insurance and bonds required by such agencies. The costs incurred by the CONTRACTOR in compliance with this paragraph shall not be made the basis for claims for additional compensation. The OWNER shall assist the CONTRACTOR, when necessary, in obtaining such permits and licenses. The CONTRACTOR shall pay all governmental charges and inspection fees necessary for the prosecution of the WORK, which are applicable at the time of opening of Bids, including all utility connection charges for utilities required by the WORK.

B. The CONTRACTOR shall pay all license fees and royalties and assume all costs when any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others when issued in the construction of the WORK or incorporated into the WORK. If a particular invention, design, process, product, or device is specified in the Contract Documents for incorporation into or use in the construction of the WORK and if to the actual knowledge of the OWNER or the ENGINEER its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of these rights shall be disclosed by the OWNER in the Contract Documents. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER and the ENGINEER and anyone directly or indirectly employed by either of them from and against all claims, damages, losses, and expenses (including attorneys' fees and court costs) arising out of any infringement of patent rights or copyrights incident to the use in the performance of the WORK or resulting from the incorporation in the WORK of any invention, design, process, product, or device not specified in the Contract Documents.

6.07 LAWS AND REGULATIONS

A. The CONTRACTOR shall observe and comply with all Laws and Regulations which in any manner affect those engaged or employed on the WORK, the materials used in the WORK, or the conduct of the WORK. If any discrepancy or inconsistency should be discovered in the Contract Documents in relation to any Laws or Regulations, the CONTRACTOR shall report the same in writing to the OWNER. Notwithstanding any immunity otherwise provided by applicable workers' compensation statutes, the CONTRACTOR shall indemnify, defend and hold harmless the OWNER, the ENGINEER and their officers, agents, and employees against all claims arising from violation of any

Laws or Regulations, by CONTRACTOR or by its employees or subcontractors. This indemnity provision is intended to provide the greatest protection of the OWNER and ENGINEER allowed by law. Any particular law or regulation specified or referred to elsewhere in the Contract Documents shall not in any way limit the obligation of the CONTRACTOR to comply with all other provisions of federal, state, and local laws and regulations.

6.08 EQUAL OPPORTUNITY

A. The CONTRACTOR agrees not to discriminate against anyone because of race, national origin, ancestry, color, religion, sex, age, or disability. The CONTRACTOR agrees to abide by all applicable civil rights Laws and Regulations.

6.09 TAXES

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

6.10 USE OF PREMISES

A. The CONTRACTOR shall confine construction equipment, stored materials and equipment, and other operations of workers to (1) the Project site, (2) the land and areas identified for the CONTRACTOR's use in the Contract Documents, and (3) other lands whose use is acquired by Laws and Regulations, rights-of-way, permits, and easements. The CONTRACTOR shall be fully responsible to the owner and occupant of such lands for any damage to the lands or areas contiguous thereto, resulting from the performance of the WORK or otherwise. Should any claim be made against the OWNER or the ENGINEER by owner or occupant of lands because of the performance of the WORK, the CONTRACTOR shall promptly settle the claim by agreement, or resolve the claim through litigation. The CONTRACTOR shall, to the fullest extent permitted by Laws and Regulations, indemnify, defend, and hold the OWNER and the ENGINEER harmless from and against all claims, damages, losses, and expenses (including, but not limited to, fees of engineers, architects, attorneys, and other professionals and court costs) arising directly, indirectly, or consequentially out of any action, legal or equitable, brought by any owner or occupant of land against the OWNER or the ENGINEER to the extent the claim is based or arises out of the CONTRACTOR's performance of the WORK.

6.11 SAFETY AND PROTECTION

A. The CONTRACTOR shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the WORK. The CONTRACTOR shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. All persons on or near the work site and other persons and organizations who may be affected by activities on or near the work site.

2. All the WORK and materials and equipment to be incorporated therein, whether in storage on or off the site; and

3. Other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

B. The CONTRACTOR shall comply with all applicable Laws and Regulations (whether referred to herein or not) of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss and shall erect and maintain all necessary safeguards for such safety and protection. The CONTRACTOR shall notify owners of adjacent property and utilities when prosecution of the WORK may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Unless the CONTRACTOR otherwise designates in writing a different individual as the responsible individual, the CONTRACTOR's superintendent shall be CONTRACTOR's representative at the site whose duties shall include providing all persons on the work site with a reasonably safe environment and the prevention of accidents.

6.12 SHOP DRAWINGS AND SAMPLES

A. After checking and verifying all field measurements and after complying with the applicable procedures specified in the General Requirements, the CONTRACTOR shall submit all shop drawings to the OWNER for review and approval in accordance with the approved schedule for shop drawing submittals specified in the General Requirements.

B. The CONTRACTOR shall also submit to the OWNER for review and approval all samples in accordance with the approved schedule of sample submittals specified in the General Requirements.

C. Before submitting shop drawings or samples, the CONTRACTOR shall determine and verify all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers, and similar data with respect thereto and review or coordinate each shop drawing or sample with other shop drawings and samples and with the requirements of the WORK and the Contract Documents. The CONTRACTOR shall stamp each shop drawing, certifying his review. If the same shop drawings require re-submittal more than two times, the CONTRACTOR shall pay for the costs of ENGINEER’s and OWNER’s subsequent review(s).

6.13 CONTINUING THE WORK

A. The CONTRACTOR shall carry on the WORK and adhere to the progress schedule during all disputes or disagreements with the OWNER. No work shall be delayed or postponed pending resolution of any dispute or disagreement, except as the CONTRACTOR and the OWNER may otherwise mutually agree in writing.

6.14 INDEMNIFICATION

A. To the fullest extent permitted by Laws and Regulations, and notwithstanding any immunity the CONTRACTOR might otherwise have under applicable workers’ compensation statutes, the CONTRACTOR shall indemnify, defend, and hold harmless the OWNER, the ENGINEER, and their officers, agents, and employees, against and from all claims and liability arising under or by reason of, or claimed by others to arise under or

by reason of, the Agreement or any performance of the WORK, but not from the sole negligence or willful misconduct of the OWNER and/or the ENGINEER. Such indemnification by the CONTRACTOR shall include but not be limited to the following:

1. Liability or claims resulting in whole or in part, directly or indirectly from, or claimed by others to result in whole or in part, directly or indirectly from, the negligence, carelessness or other fault of the CONTRACTOR or its employees, Subcontractors, Suppliers or agents in the performance of the WORK, or in guarding or maintaining the same, or from any improper materials, implements, or appliances used in its construction;

2. Liability or claims arising in whole or in part, directly or indirectly, from or based on, or claimed by others to arise in whole or in part, directly or indirectly, from or based on, the violation of any Laws or Regulations by the CONTRACTOR or its employees, Subcontractors, Suppliers or agents;

3. Liability or claims arising in whole or in part, directly or indirectly, from, or claimed by others to arise in whole or in part, directly or indirectly from, the use or manufacture by the CONTRACTOR, or its Subcontractors, Suppliers or agents in the performance of this Agreement of any copyrighted or uncopyrighted composition, secret process, patented or unpatented invention, article, or appliance, unless otherwise specifically stipulated in this Agreement.

4. Liability or claims arising in whole or in part, directly or indirectly, from, or claimed by others to arise in whole or in part, directly or indirectly from, the breach of any warranties, whether express or implied, made by the CONTRACTOR or its Subcontractors, Suppliers or agents;

5. Liabilities or claims arising in whole or in part, directly or indirectly, from, or claimed by others to arise in whole or in part, directly or indirectly from, the willful misconduct of the CONTRACTOR or its Subcontractors, Suppliers or agents; and,

6. Liabilities or claims arising in whole or in part, directly or indirectly, from, or claimed by others to arise in whole or in part, directly or indirectly from, any breach of the obligations assumed herein by the CONTRACTOR or its Subcontractors, Suppliers or agents.

7. If for any reason the OWNER is required to pay damages in proportion to the fault of the OWNER notwithstanding the above indemnity provisions, CONTRACTOR shall, notwithstanding any workers' compensation immunity, indemnify and hold OWNER harmless from the payment of any increased damages OWNER is required to pay which result from a reapportionment of the fault of the CONTRACTOR, or any of its employees, Subcontractors or Suppliers pursuant to Utah Code Annotated section 78b-5-818, Comparative negligence.

B. The CONTRACTOR shall reimburse the OWNER, and the ENGINEER for all costs and expense, (including but not limited to fees and charges of engineers, architects, attorneys, and other professional and court costs) incurred by the OWNER, and the ENGINEER in enforcing the provisions of this Paragraph.

C. The indemnification obligation under this Paragraph shall not be limited in any way by any limitation of the amount or type of damages, compensation, or benefits payable by or for the CONTRACTOR or any such subcontractor or other person or organization under workers' compensation acts, disability benefit acts, or other employee benefit acts.

6.15 CONTRACTOR'S DAILY REPORTS

A. The CONTRACTOR shall complete a daily report indicating manpower, major equipment, subcontractors, weather conditions, etc., involved in the performance of the WORK. The daily report shall be completed on forms prepared by the CONTRACTOR and acceptable to the OWNER, and shall be submitted to the OWNER at the conclusion of each workday.

6.16 ASSIGNMENT OF CONTRACT

A. The CONTRACTOR shall not assign, sublet, sell, transfer, or otherwise dispose of the Agreement or any portion thereof, or its right, title, or interested therein, or obligations thereunder, without the written consent of the OWNER except as imposed by law. If the CONTRACTOR violates this provision, the Agreement may be terminated at the option of the OWNER. In such event, the OWNER shall be relieved of all liability and obligations to the CONTRACTOR and to its assignee or transferee, growing out of such termination.

ARTICLE 7 – OTHER WORK

7.01 RELATED WORK

A. The OWNER may perform other work related to the Project at the site by the OWNER's own forces, have other work performed by utility owners, or let other direct contracts for the performance of the other work which may contain General Conditions similar to these. If the fact that such other work is to be performed was not noted in the Contract Documents written notice thereof will be given to the CONTRACTOR prior to commencing any other work.

B. The CONTRACTOR shall afford each utility owner and other contractor who is a party to a direct contract (or the OWNER, if the OWNER is performing the additional work with the OWNER's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of the other work. The CONTRACTOR shall properly connect and coordinate the WORK with the other work. The CONTRACTOR shall do all cutting, fitting, and patching of the WORK that may be required to make its several parts come together properly and integrate with the other work. The CONTRACTOR shall not endanger any work of others by cutting, excavating, or otherwise altering their work and shall only cut or alter their work with the written consent of the OWNER and the others whose work will be affected.

C. If the proper execution or results of any part of the CONTRACTOR's work depends upon the integration of work with the completion of other work by any other contractor or utility owner (or the OWNER), the CONTRACTOR shall inspect and report to the OWNER in writing all delays, defects, or deficiencies in the other work that renders it unavailable or unsuitable for proper integration with the CONTRACTOR's work. Except for the results or effects of material latent defects and deficiencies in the other work which could not reasonably have been discovered by the CONTRACTOR, the CONTRACTOR's failure to report will constitute an acceptance of the other work as fit and proper for integration

with the CONTRACTOR's work and as a waiver of any claim for additional time or compensation associated with the integration of the CONTRACTOR's work with the other work.

7.02 COORDINATION

A. If the OWNER contracts with others for the performance of other work on the Project at the site, a coordinator will be identified to the extent that the coordinator can be identified at this time, in the Supplementary General Conditions and delegated the authority and responsibility for coordination of the activities among the various contractors. The specific matters over which the coordinator has authority and the extent of the coordinator's authority and responsibility will be itemized in the Supplementary General Conditions or in a notice to the CONTRACTOR at such time as the identity of the coordinator is determined.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 COMMUNICATIONS

A. The OWNER shall issue all its communications directly to the CONTRACTOR.

8.02 PAYMENTS

A. The OWNER shall make payments to the CONTRACTOR as provided in Article 14.

8.03 LANDS, EASEMENTS, AND SURVEYS

A. The OWNER's duties with respect to providing lands and easements and providing engineering surveys to establish reference points are set forth in Paragraphs 4.01 and 4.05. The OWNER shall identify and make available to the CONTRACTOR copies of exploration reports and subsurface conditions tests at the site and in existing structures which have been utilized in preparing the Drawings and Technical Specifications as set forth in Paragraph 4.02

8.04 CHANGE ORDERS

A. The OWNER shall execute approved Change Orders for the conditions described in Paragraph 10.01D.

B. When funds are not budgeted to support continuation of performance in a subsequent fiscal period, the contract shall be canceled and the contractor shall be reimbursed for the reasonable value of any non-recurring costs incurred but not amortized in the price of the supplies or services delivered under the contract.

8.05 INSPECTIONS AND TESTS

A. The OWNER's responsibility with respect to inspection, tests, and approvals is set forth in Paragraph 13.03B.

8.06 SUSPENSION OF WORK

A. In connection with the OWNER's right to stop work or suspend work, see Paragraphs 13.04 and 15.01, Paragraphs 15.02 and 15.03 deal with the OWNER's right to terminate services of the CONTRACTOR under certain circumstances.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S REPRESENTATIVE

A. The OWNER will designate a representative during the construction period. The duties, responsibilities and the limitations of authority of the OWNER's representative during construction are summarized hereafter.

9.02 VISITS TO SITE

A. The ENGINEER will make visits to the site during construction to observe and inspect the progress and quality of the WORK and to determine, in general if the WORK is proceeding in accordance with the Contract Documents.

9.03 PROJECT REPRESENTATIVE

A. The OWNER'S Representative will observe and inspect the performance of the WORK. The Owner's Representative and/or other authorized agents of the OWNER shall serve as the primary contact(s) with the Contractor during the construction phase. All submittals shall be delivered to, and communications between the OWNER and the CONTRACTOR shall be handled by, the Owner's Representative and/or other authorized agents. The Owner's Representative shall be the primary authorized representative of the OWNER in all on-site relations with the CONTRACTOR.

9.04 CLARIFICATIONS AND INTERPRETATIONS

A. The OWNER will issue, with reasonable promptness written clarifications or interpretations of the requirements of the Contract Documents (in the form of Drawings or otherwise) as the OWNER may determine necessary, which shall be consistent with or reasonably inferable from the overall intent of the Contract Documents.

9.05 AUTHORIZED VARIATIONS IN WORK

A. The OWNER may authorize minor variations in the WORK as described in the Contract Documents when such variations do not involve an adjustment in the Contract Price or the Contract Time and are consistent with the overall intent of the Contract Documents. These variations shall be accomplished by issuing a Field Order. The issuance of a Field Order requires the CONTRACTOR to perform the work described in the order promptly. If the CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time and the parties are unable to agree as to the amount or extent thereof, the CONTRACTOR may make a claim therefor as provided in Article 11 and 12.

9.06 REJECTION OF DEFECTIVE WORK

A. The OWNER is authorized to reject work which the OWNER believes to be defective and require special inspection or testing of the WORK as provided in Paragraph 13.03G, whether or not the WORK is fabricated, installed, or completed.

9.07 CONTRACTOR SUBMITTALS, CHANGE ORDERS, AND PAYMENTS

A. The OWNER will review for approval all CONTRACTOR submittals, including shop drawings, samples, substitutes, and "or equal" items, etc., in accordance with the procedures set forth in the General Requirements.

B. In connection with the OWNER's REPRESENTATIVE responsibilities as to Change Orders, see Articles 10, 11, and 12.

C. In connection with the OWNER responsibilities as to Applications for Payment, see Article 14.

9.08 DISPUTES, CLAIMS AND OTHER MATTERS

A. All claims, disputes, and other matters concerning the acceptability of the WORK, the interpretation of the requirements of the Contract Documents pertaining to the performance of the WORK, and claims for changes in the Contract Price or Contract Time under Articles 11 and 12 will be referred to the OWNER in writing with a request for formal decision in accordance with this paragraph. The OWNER will render a decision in writing within 30 days of receipt of the request. Written notice of each claim, dispute, or other matter will be delivered by the CONTRACTOR to the OWNER promptly (but in no event later than 30 days) after the occurrence of the event. Written supporting data will be submitted to the OWNER with the written claim unless the OWNER allows an additional period of time to ascertain more accurate data in support of the claim.

B. When reviewing the claim or dispute, the OWNER'S REPRESENTATIVE will not show partiality to the OWNER or the CONTRACTOR and will incur no liability in connection with any interpretation or decision rendered in good faith. The OWNER'S REPRESENTATIVE rendering of a decision with respect to any claim, dispute, or other matter (except any which have been waived by the making or acceptance of final payment as provided in Paragraph 14.12) shall be a condition precedent to the OWNER's or the CONTRACTOR's exercise of their rights or remedies under the Contract Documents or by Law or Regulations with respect to the claim, dispute, or other matter.

9.09 LIMITATION ON ENGINEER'S RESPONSIBILITIES

A. Whenever in the Contract Documents the terms "as ordered," "as directed," "as required," as allowed," "as reviewed," "as approved," or terms of like effect or import are used, or the adjectives "reasonable," "suitable," "acceptable," "proper," or "satisfactory" or adjectives of like effect or import are used to describe a requirement, direction, review, or judgment of the OWNER as to the WORK, it is intended that such requirement, direction, review, or judgment will be solely to evaluate the WORK for compliance with the Contract Documents, unless there is a specific statement indicating otherwise. The use of any such term or adjective shall not be effective to assign to the OWNER any duty or authority to supervise or direct the performance of the WORK.

B. Neither the OWNER nor the ENGINEER will be responsible for the CONTRACTOR's means, methods, techniques, sequences, or procedures of construction not specified in the Contract Documents. Neither the OWNER nor the ENGINEER shall have any responsibility for safety precautions or programs on site or for the safety of CONTRACTOR'S employees, Subcontractors, employees of Subcontractors, Suppliers, employees of Suppliers or others on site.

C. Neither the OWNER nor the ENGINEER will be responsible for the acts or omissions of the CONTRACTOR nor of any Subcontractor, Supplier, or any other person or organization performing any of the WORK to the extent that such acts or omissions are not reasonably discoverable considering the level of observation and inspection required by the ENGINEER's agreement with the OWNER.

ARTICLE 10 – CHANGES IN THE WORK

10.01 GENERAL

A. Without invalidating the Agreement and without notice to any surety, the OWNER may at any time or from time to time, order additions, deletions, or revisions in the WORK; these will be authorized by a written Field Order and/or a Change Order issued by the OWNER. Upon receipt of any of these documents, the CONTRACTOR shall promptly proceed with the work involved pursuant to the applicable conditions of the Contract Documents.

B. If the OWNER and the CONTRACTOR are unable to agree upon the increase or decrease in the Contract Price or an extension or shortening of the Contract Time, if any, that should be allowed as a result of a Field Order, a claim may be made therefor as provided in Articles 11 and 12.

C. The CONTRACTOR shall not be entitled to an increase in the Contract Price nor an extension of the Contract Time with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented by Change Order, except in the case of an emergency and except in the case of uncovering work provided in the Paragraph 13.03G.

D. The OWNER and the CONTRACTOR shall execute appropriate Change Orders covering:

1. Changes in the WORK which are ordered by the OWNER pursuant to Paragraph 10.01A;

2. Changes required because of acceptance of defective work under Paragraph 13.06;

3. Changes in the Contract Price or Contract Time which are agreed to by the parties; or

4. Any other changes agreed to by the parties.

5. Any construction contract change order which increases the contract amount shall have the prior written certification of the District's controller that the expenditure of the change order amount is properly authorized by the District's board of trustees

consistent with the District's budget and financial management policies and the instructions of the board of trustees.

E. If the provisions of any Bond require notice of any change to be given to a surety, the giving of these notices will be the CONTRACTOR's responsibility. The CONTRACTOR shall provide for the amount of each applicable Bond to be adjusted accordingly.

10.02 ALLOWABLE QUANTITY VARIATIONS

A. Whenever a unit price and quantity have been established for a bid item in the Contract Documents, the quantity stated may be increased or decreased to a maximum of 25 percent with no change in the unit price. An adjustment in the quantity in excess of 25 percent will be sufficient to justify a change in the unit price. All changes in the quantities of bid items shall be documented by Change Order.

B. In the event a part of the WORK is to be entirely eliminated and no lump sum or unit price is named in the Contract Documents to cover the eliminated work, the price of the eliminated work shall be agreed upon in writing by the OWNER and the CONTRACTOR. If the OWNER and the CONTRACTOR fail to agree upon the price of the eliminated work, the price shall be determined in accordance with the provisions of Article 11.

ARTICLE 11 – CHANGE OF CONTRACT PRICE

11.01 GENERAL

A. The Contract Price constitutes the total compensation payable to the CONTRACTOR for performing the WORK. Except as directed by Change Orders, all duties, responsibilities, and obligations assigned to or undertaken by the CONTRACTOR shall be at its expense without change in the Contract Price.

B. The Contract Price may only be changed by a Change Order. Any claim for an increase in the Contract Price shall be based on written notice delivered by the CONTRACTOR to the OWNER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the amount of the claim with supporting data shall be delivered with the claim, unless the OWNER allows an additional period of time to ascertain more accurate data in support of the claim, and shall be accompanied by the CONTRACTOR's written statement that the amount claimed covers all known amounts (direct, indirect, and consequential) to which the CONTRACTOR is entitled as a result of the occurrence of the event. If the OWNER and the CONTRACTOR cannot otherwise agree on the amount involved, all claims for adjustment in the Contract Price shall be determined by the OWNER in accordance with Paragraph 9.08A. No claim for an adjustment in the Contract Price will be valid if not submitted in accordance with this paragraph.

C. The value of any work covered by a Change Order or of any claim for an increase or decrease in the Contract Price shall be determined in one of the following ways:

1. Where the work involved is covered by unit prices contained in the Contract Documents, by application of unit prices to the quantities of the items involved.

2. Mutual acceptance of a lump sum, which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.

3. On the basis of the cost of work (determined as provided in Paragraphs 11.02 and 11.03) plus a CONTRACTOR's fee for overhead and profit (determined as provided in Paragraph 11.04).

11.02 COST OF WORK (BASED ON TIME AND MATERIALS)

A. General: The term "cost of work" means the sum of all costs necessarily incurred and paid by the CONTRACTOR for labor, materials, and equipment in the proper performance of work. Except as otherwise may be agreed to in writing by the OWNER, such costs shall be in amounts no higher than those prevailing in the locality of the Project.

B. Labor: The cost of labor used in performing work by the CONTRACTOR, a Subcontractor, or other forces will be the sum of the following:

1. The actual wages paid plus any employer payments to, or on behalf of workers for fringe benefits including health and welfare, pension, vacation, and similar purposes. The cost of labor may include the rates paid to foremen when determined by the OWNER that the services of foremen do not constitute a part of the overhead allowance.

2. All payments imposed by state and federal laws including, but not limited to, compensation insurance, and social security payments.

3. The amount paid for subsistence and travel required by collective bargaining agreements, or in accordance with the regular practice of the employer.

4. At the beginning of the extra work and as later requested by the OWNER, the CONTRACTOR shall furnish the OWNER proof of labor compensation rates being paid.

C. Materials: The cost of materials used in performing work will be the cost to the purchaser, whether CONTRACTOR or Subcontractor, from the Supplier thereof, except as the following are applicable:

1. Trade discounts available to the purchase shall be credited to the OWNER notwithstanding the fact that such discounts may not have been taken by the CONTRACTOR.

2. For materials secured by other than a direct purchase and direct billing to the purchaser, the cost shall be deemed to be the price paid to the actual Supplier as determined by the OWNER. Markup except for actual costs incurred in the handling of such materials will not be allowed.

3. Payment for materials from sources owned wholly or in part by the purchaser shall not exceed the price paid by the purchaser for similar materials from these sources on extra work items or current wholesale price for the materials delivered to the work site, whichever is lower.

4. If, in the opinion of the OWNER, the cost of material is excessive, or the CONTRACTOR does not furnish satisfactory evidence of the cost of the material, then the cost shall be deemed to be the lowest current wholesale price for the quantity concerned, delivered to the work site less trade discount. The OWNER reserves the right to furnish materials for the extra work and no claim shall be made by the CONTRACTOR for costs and profit on such materials.

D. Equipment: The CONTRACTOR will be paid for the use of equipment at the rental rate listed for the equipment specified in the Rental Rate Blue Book published by Dataquest, Inc. The rental rate will be used to compute payments for equipment whether the equipment is under the CONTRACTOR's control through direct ownership, leasing, renting, or another method of acquisition. The rental rate to be applied for use of each item of equipment shall be the rate resulting in the least total cost to the Owner for the total period of use.

1. All equipment shall, in the opinion of the OWNER, be in good working condition and suitable for the purpose for which the equipment is to be used.

2. Before construction equipment is used on the extra work, the CONTRACTOR shall plainly stencil or stamp an identifying number thereon at a conspicuous location, and shall furnish to the OWNER, in duplicate, a description of the equipment and its identifying number.

3. Unless otherwise specified, manufacturers' ratings and manufacturer-approved modifications shall be used to classify equipment for the determination of applicable rental rates. Equipment which has no direct power unit shall be powered by a unit of at least the minimum rating recommended by the manufacturer.

4. Individual pieces of equipment or tools having a replacement value of $100 or less, whether or not consumed by use, shall be considered to be small tools and no payment will be made therefore.

5. Rental time will not be allowed while equipment is inoperative due to breakdowns.

E. Equipment on the Work: The rental time to be paid for equipment used on the WORK shall be the time the equipment is in productive operation on the extra work being performed and, in addition, shall include the time required to move the equipment to the location of the extra work and return it to the original location or to another location that requires no more moving time than that required to return it to its original location. Moving time will not be paid if the equipment is used on other than the extra work, even though located at the site of the extra work. Loading and transporting costs will be allowed, in lieu of moving time, when the equipment is moved by means other than its own power. However, no payment will be made for loading and transporting costs when the equipment is used on other than the extra work even though located at the site of the extra work. The following shall be used in computing the rental time of equipment on the WORK.

1. When hourly rates are listed, any part of an hour less than 30 minutes of operation shall be considered to be 1/2-hour of operation, and any part of an hour in excess of 30 minutes will be considered one hour of operation.

2. When daily rates are listed, any part of a day less than 4 hours operation shall be considered to be 1/2-day of operation. When owner-operated equipment is used to perform extra work to be paid for on a time and materials basis, the CONTRACTOR will be paid for the equipment and operator, as set forth in Paragraph (3), (4), and (5), following.

3. Payment for the equipment will be made in accordance with the provisions in Paragraph 11.02D, herein.

4. Payment for the cost of labor and subsistence or travel allowance will be made at the rates paid by the CONTRACTOR to other workers operating similar equipment already on the WORK, or in the absence of such labor, established by collective bargaining agreements for the type of workmen and location of the extra work, whether or not the operator is actually covered by such an agreement. A labor surcharge will be added to the cost of labor described herein in accordance with the provisions of Paragraph 11.02B, herein, which surcharge shall constitute full compensation for payments imposed by state and federal laws and all payments made to on behalf of workers other than actual wages.

5. To the direct cost of equipment rental and labor, computed as provided herein, will be added the allowances for equipment rental and labor as provided in Paragraph 11.04, herein.

11.03 SPECIAL SERVICES

A. Special work or services are defined as that work characterized by extraordinary complexity, sophistication, or innovation or a combination of the foregoing attributes which are unique to the construction industry. The following may be considered by the OWNER in making estimates for payment for special services:

1. When the OWNER and the CONTRACTOR, by agreement, determine that a special service or work is required which cannot be performed by the forces of the CONTRACTOR or those of any of its Subcontractors, the special service or work may be performed by an entity especially skilled in the work to be performed. After validation of invoices and determination of market values by the OWNER, invoices for special services or work based upon the current fair market value thereof may be accepted without complete itemization of labor, material, and equipment rental cost.

2. When the CONTRACTOR is required to perform work necessitating special fabrication or machining process in a fabrication or a machine shop facility away from the job site, the charges for that portion of the work performed at the off-site facility may by agreement, be accepted as a special service and accordingly, the invoices from the work may be accepted without detailed itemization.

3. All invoices for special services will be adjusted by deducting all trade discounts offered or available, whether the discounts were taken or not. In lieu of the allowances for overhead and profit specified in Paragraph 11.04, herein, an allowance of 5 percent will be added to invoices for special services.

B. All work performed hereunder shall be subject to all of the provisions of the Contract Documents and the CONTRACTOR's sureties shall be bound with reference hereto as under the original Agreement. Copies of all amendments to surety bonds or supplemental surety bonds shall be submitted to the OWNER for review prior to the performance of any work hereunder.

11.04 CONTRACTOR'S FEE

A. Work ordered on the basis of time and materials will be paid for at the actual necessary cost as determined by the OWNER, plus allowances for overhead and profit. For extra work involving a combination of increases and decreases in the WORK, the actual necessary cost will be the arithmetic sum of the additive and deductive costs. The allowance for overhead and profit shall include full compensation for superintendence, bond and insurance premiums, taxes, office expenses, and all other items of expense or cost not included in the cost of labor, materials, or equipment provided for under Paragraphs 11.02B, C, and D herein, including extended overhead and home office overhead. The allowance for overhead and profit will be made in accordance with the following schedule:

OVERHEAD AND PROFIT ALLOWANCE

Labor ……	10 percent
Materials ……..	10 percent
Equipment ……...	10 percent

B. It is understood that labor, materials, and equipment may be furnished by the CONTRACTOR or by a Subcontractor, and that the allowance specified herein shall be applied to the labor, materials, and equipment costs of the Subcontractor, to which the CONTRACTOR may add five percent of the Subcontractor's total cost of work. Regardless of the number of hierarchical tiers of Subcontractors, the five-percent markup may be applied one time only for each separate work transaction.

ARTICLE 12 – CHANGE OF CONTRACT TIME

12.01 GENERAL

A. The Contract Time may only be changed by a Change Order. Any claim for an extension of the Contract time shall be based on written notice delivered by the CONTRACTOR to the OWNER promptly (but in no event later than 30 days) after the occurrence of the event giving rise to the claim and stating the general nature of the claim. Notice of the extent of the claim with supporting data shall be delivered within 30 days after such occurrence (unless the OWNER allows an additional period of time to ascertain more accurate data in support of the claim) and shall be accompanied by the CONTRACTOR's written statement that the adjustment claimed is the entire adjustment to which the CONTRACTOR has reason to believe it is entitled as a result of the occurrence of said event. Claims for adjustment in the Contract Time shall be determined by the OWNER in accordance with Paragraph 9.08 if the OWNER’s representative and the CONTRACTOR cannot otherwise agree. No claim for an adjustment in the Contract Time will be valid if not submitted in accordance with the requirements of this paragraph.

B. The Contract Time will be extended in an amount equal to time lost if the CONTRACTOR makes a claim as provided in Paragraph 12.01A and the OWNER determines that the delay was caused by events beyond the control of the CONTRACTOR. Examples of events beyond the control of the CONTRACTOR include acts or neglect by the OWNER or others performing additional work as contemplated by Article 7, or by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, sabotage, or freight embargoes.

C. All time limits stated in the Contract Documents are of the essence.

D. None of the aforesaid time extensions shall entitle the CONTRACTOR to any adjustment in the Contract Price or any damages for delay. Furthermore, the CONTRACTOR hereby indemnifies and holds harmless the OWNER and ENGINEER, their officers, agents and employees from and against all claims, damages, losses and expenses (including lost property and attorney's fees) arising out of or resulting from the temporary suspension of work whether for the OWNER's convenience as defined in Article 15.01A or for whatever other reasons including the stoppage of work by the OWNER for the CONTRACTOR's failure to comply with any order issued by the OWNER.

12.02 EXTENSIONS OF THE TIME FOR DELAY DUE TO INCLEMENT WEATHER

A. "Inclement weather" is any weather condition or conditions resulting immediately therefrom, causing the CONTRACTOR to suspend construction operations or preventing the CONTRACTOR from proceeding with at least 75 percent of the normal labor and equipment force engaged on the WORK.

B. Should the CONTRACTOR prepare to begin work at the regular starting time at the beginning of any regular work shift on any day on which inclement weather, or its effects on the condition of the WORK prevents work from beginning at the usual starting time and the crew is dismissed as a result thereof, the CONTRACTOR will not be charged for a working day whether or not conditions change thereafter during the day and the major portion of the day could be considered to be suitable for construction operations.

C. The CONTRACTOR shall base its construction schedule upon the inclusion of the number of days of inclement weather specified in the Supplementary General Conditions. No extension of the Contract Time due to inclement weather will be considered until after the stated number of days of inclement weather has been reached. However, no reduction in Contract Time will be made if the number of inclement weather days is not reached.

12.03 EXTENSIONS OF TIME FOR OTHER DELAYS

A. If the CONTRACTOR is delayed in completion of the WORK beyond the Contract Time, by acts of God or of the public enemy, fire, floods, epidemics, quarantine restrictions, strikes, labor disputes, industry-wide shortage of raw materials, sabotage or freight embargoes, the CONTRACTOR shall be entitled to an adjustment in the Contract Time. No such adjustment will be made unless the CONTRACTOR shall notify the OWNER in writing of the causes of delay within 15 calendar days from the beginning of any such delay. The OWNER shall ascertain the facts and the extent of the delay. No adjustment in time shall be made for delays resulting from noncompliance with the Contract Documents, accidents, failure on the part of the CONTRACTOR to carry out the provisions of the Contract Documents including failure to provide materials, equipment or

workmanship meeting the requirements of the Contract Documents; the occurrence of such events shall not relieve the CONTRACTOR from the necessity of maintaining the required progress.

B. If the CONTRACTOR is delayed in completing the WORK beyond the Contract Time by reason of shortages of raw materials required for CONTRACTOR-furnished items, the CONTRACTOR shall be entitled to an adjustment in the Contract Time in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER; provided, however, that the CONTRACTOR shall furnish documentation acceptable to the OWNER that he placed or attempted to place firm orders with Suppliers at a reasonable time in advance of the required date of delivery of the items in question, that such shortages shall have developed following the date such orders were placed or attempts made to place same, that said shortages are general throughout the affected industry, that said shortages are shortages of raw materials required to manufacture CONTRACTOR furnished items and not simply failure of CONTRACTOR's Suppliers to manufacture, assemble or ship items on time, and that the CONTRACTOR shall, to the degree possible, have made revisions in the sequence of his operations, within the terms of the Contract Documents, to offset the expected delay. The CONTRACTOR shall notify the OWNER, in writing, concerning the cause of delay, within 15 calendar days of the beginning of such delay. The validity of any claim by the CONTRACTOR to an adjustment in the Contract Time shall be determined by the OWNER, and his findings thereon shall be based on the OWNER's knowledge and observations of the events involved and documentation submitted by the CONTRACTOR, showing all applicable facts relative to the foregoing provisions. Only the physical shortage of raw materials will be considered under these provisions as a cause for adjustment of time and no consideration will be given to any claim that items could not be obtained at a reasonable, practical, or economical cost or price, unless it is shown to the satisfaction of the OWNER that such items could have been obtained only at exorbitant prices entirely out of line with current rates taking into account the quantities involved and the usual practices in obtaining such quantities.

C. If the CONTRACTOR is delayed in completion of the WORK by any act of the OWNER not authorized by the Contract Documents, an adjustment in the Contract Time will be made by the OWNER in like manner as if the WORK had been suspended for the convenience and benefit of the OWNER. In the event of such delay, the CONTRACTOR shall notify the OWNER in writing of the causes of delay within 15 calendar days from the beginning of any such delay.

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

13.01 WARRANTY, GUARANTEE AND CORRECTION PERIOD

A. The CONTRACTOR warrants and guarantees to the OWNER and the ENGINEER that all work, equipment, materials and workmanship are in accordance with the Contract Documents and are not defective. Reasonably prompt notice of defects discovered by the OWNER or ENGINEER shall be given to the CONTRACTOR. All defective work, whether or not in place, may be rejected, corrected, or accepted as provided in this Article 13.

B. If within one (1) year after the date of final completion, as set by the Contractor's Certificate of Final Completion, or a longer period of time prescribed by Laws or Regulations or by the terms of any applicable special guarantee or specific provisions of the Contract

Documents, any part of the WORK is found to be defective, the OWNER shall notify the CONTRACTOR in writing and the CONTRACTOR shall promptly, without cost to the OWNER and in accordance with the OWNER's written notification, either correct the defective work, or, if it has been rejected by the OWNER, remove it from the site and replace it with non-defective work. In the event the CONTRACTOR does not promptly comply with the notification, or in an emergency where delay would cause serious risk of loss or damage, the OWNER may have the defective work corrected or rejected work removed and replaced. All direct, indirect, and consequential costs of the removal and replacement including but not limited to fees and charges of engineers, architects, attorneys and other professionals will be paid by the CONTRACTOR. This paragraph shall not be construed to limit nor diminish the CONTRACTOR's absolute guarantee to complete the WORK in accordance with the Contract Documents.

13.02 ACCESS TO WORK

A. The ENGINEER, other representatives of the OWNER, testing agencies, and governmental agencies with jurisdictional interests shall have access to the work at reasonable times for their observation, inspections, and testing. The CONTRACTOR shall provide proper and safe conditions for their access.

13.03 TESTS AND INSPECTIONS

A. The CONTRACTOR shall give the OWNER timely notice of readiness of the WORK for all required inspections, tests, or approvals.

B. If Laws or Regulations of any public body other than the OWNER, with jurisdiction over the WORK require any work to be specifically inspected, tested, or approved, the CONTRACTOR shall pay all costs in connection therewith. The CONTRACTOR shall also be responsible for and shall pay all costs in connection with any inspection or testing required in connection with the OWNER's acceptance of a Supplier of materials or equipment proposed as a substitution or "or-equal" to be incorporated in the WORK and of materials or equipment submitted for review prior to the CONTRACTOR's purchase for incorporation in the WORK. The cost of all inspections, tests, and approvals, with the exception of the above which are required by the Contract Documents, shall be paid by the OWNER (unless otherwise specified).

C. The OWNER will make, or have made, such inspections and tests as the OWNER deems necessary to see that the WORK is being accomplished in accordance with the Contract Documents. The CONTRACTOR, without additional cost to the OWNER, shall provide the labor and equipment necessary to make the WORK available for inspections. Unless otherwise specified in the Supplementary General Conditions, all other costs of inspection and testing will be borne by the OWNER. In the event the inspections or tests reveal non-compliance with the requirements of the Contract Documents, the CONTRACTOR shall bear the cost of corrective measures deemed necessary by the OWNER, as well as the cost of subsequent re-inspection and retesting. Neither observations by the OWNER nor inspections, tests, or approvals by others shall relieve the CONTRACTOR from the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

D. All inspections, tests, or approvals other than those required by Laws or Regulations of any public body having jurisdiction shall be performed by properly licensed organizations selected by the OWNER.

E. If any work (including the work of others) that is to be inspected, tested, or approved is covered without the OWNER's written authorization, it must, if requested by the OWNER, be uncovered for testing, inspection, and observation. The uncovering shall be at the CONTRACTOR's expense unless the CONTRACTOR timely notified the OWNER of the CONTRACTOR's intention to cover the same and the OWNER failed to act with reasonable promptness in response to the notice.

F. If any work is covered contrary to the written request of the OWNER, it must, if requested by the OWNER, be uncovered for the OWNER's observation at the CONTRACTOR's expense.

G. If the OWNER considers it necessary or advisable that covered work be observed, inspected or tested by the OWNER or others, the OWNER shall direct the CONTRACTOR to uncover, expose, or otherwise make available for observation, inspection, or testing that portion of the work in question. The CONTRACTOR shall comply with the OWNER's direction and furnish all necessary labor, material, and equipment. If the work is defective, the CONTRACTOR shall bear all direct, indirect and consequential costs of uncovering, exposure, observation, inspection, and testing and of satisfactory reconstruction of the work, including, but not limited to, fees and charges for engineers, architects, attorneys, and other professionals. However, if the work is not defective, the CONTRACTOR shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both. The increase in Contract Time and Contract Price shall be the CONTRACTOR's actual time and costs directly attributable to uncovering and exposing the work. If the parties are unable to agree as to the amount or extent of the changes, the CONTRACTOR may make a claim therefor as provided in Articles 11 and 12.

13.04 OWNER MAY STOP THE WORK

A. If the WORK is defective, or the CONTRACTOR fails to perform work in such a way that the completed WORK will conform to the Contract Documents, the OWNER may order the CONTRACTOR to stop the WORK, or any portion thereof, until the cause for the order has been eliminated. This right of the OWNER to stop the WORK shall not give rise to any duty on the part of the OWNER to exercise this right for the benefit of the CONTRACTOR or any other party.

13.05 CORRECTION OR REMOVAL OF DEFECTIVE WORK

A. When directed by the OWNER, the CONTRACTOR shall promptly correct all defective work, whether or not fabricated, installed, or completed, or, if the work has been rejected by the OWNER, remove it from the site and replace it with non-defective work. The CONTRACTOR shall bear all direct, indirect and consequential costs of correction or removal, including but not limited to fees and charges of engineers, architects, attorneys, and other professionals made necessary thereby. If the CONTRACTOR does not correct the defective work within 30 days, the OWNER may correct the WORK and charge the CONTRACTOR for the cost of correcting the defective WORK.

13.06 ACCEPTANCE OF DEFECTIVE WORK

A. If, instead of requiring correction or removal and replacement of defective work, the OWNER prefers to accept the work, the OWNER may do so. The CONTRACTOR shall bear all direct, indirect, and consequential costs attributable to the OWNER's evaluation of and determination to accept the defective work. If any acceptance of defective work occurs prior to final payment, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the WORK, and the OWNER shall be entitled to an appropriate decrease in the Contract Price.

ARTICLE 14 – PAYMENTS TO CONTRACTOR, LIQUIDATED DAMAGES AND COMPLETION

14.01 LUMP SUM BID

A. A schedule of values or lump sum price breakdown will serve as the basis for progress payments for a lump sum Bid and will be incorporated into the form of Application for Payment included in the Contract Documents.

14.02 UNIT PRICE BID

A. Progress payments for a unit price Bid will be based on the number of units completed.

14.03 APPLICATION FOR PROGRESS PAYMENT

A. Unless otherwise prescribed by the OWNER, on the 25th of each month, the CONTRACTOR shall submit to the OWNER for review and approval, an Application for Payment completed and signed by the CONTRACTOR covering the WORK completed as of the date of the Application and accompanied by such supporting documentation as required by the Contract Documents.

B. The Application for Payment shall identify, as a sub-total, the amount of the CONTRACTOR's Total Earnings to Date, plus the Net Value of Materials On-site which have not yet been incorporated in the WORK.

C. The Net Payment Due to the CONTRACTOR shall be the above-mentioned sub-total, from which shall be deducted the retainage amount and the total amount of all previous payments made to the CONTRACTOR.

D. The OWNER may retain five percent of the amount otherwise due to the Contractor as retainage. Monies retained shall be placed in an interest-bearing account for the benefit of the CONTRACTOR.

E. Except as otherwise provided in the Supplementary General Conditions, the value of materials stored at the site shall be valued at 95 percent of the value of the materials. This amount shall be based upon the value of all acceptable materials and equipment stored at the site or at another location agreed to in writing by the OWNER; provided, each individual item has a value of more than $5000 and will become a permanent part of the WORK. The Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that the CONTRACTOR has received the materials and equipment free and clear of all liens, charges, security

interests, and encumbrances (which are hereinafter referred to as "Liens") and evidence that the materials and equipment are covered by appropriate property insurance and other arrangements to protect the OWNER's interest therein, all of which will be satisfactory to the OWNER.

14.04 CONTRACTOR'S WARRANTY OF TITLE

A. The CONTRACTOR warrants and guarantees that title to all work, materials, and equipment covered by an Application for Payment, whether incorporated in the WORK or not, will pass to the OWNER no later than the time of final payment, free and clear of all liens.

14.05 REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

A. The OWNER will, within 7 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to the OWNER, or return the Application to the CONTRACTOR indicating in writing the OWNER's reasons for refusing to recommend payment. In the latter case, the CONTRACTOR may make the necessary corrections and resubmit the Application. Thirty days after presentation of the Application for Payment with the OWNER's REPRESENTATIVE recommendation, the amount recommended will (subject to the provisions of Paragraph 14.05B) become due and when due will be paid by the OWNER to the CONTRACTOR.

B. The OWNER may refuse to make payment of the full amount recommended by the OWNER's REPRESENTATIVE to compensate for claims made by the OWNER on account of the CONTRACTOR's performance of the WORK or other items entitling the OWNER to a credit against the amount recommended, but the OWNER must give the CONTRACTOR written notice within 7 days stating the reasons for such action.

14.06 PARTIAL UTILIZATION

A. The OWNER may utilize or place into service any item of equipment or other usable portion of the WORK at any time prior to completion of the WORK. The OWNER shall notify the CONTRACTOR in writing of its intent to exercise this right. The notice will identify the equipment or specific portion or portions of the WORK to be utilized or otherwise placed into service.

B. It shall be understood by the CONTRACTOR that until such written notification is issued, all responsibility for care and maintenance of all items or portions of the WORK to be partially utilized shall be borne by the CONTRACTOR. Upon the issuance of a notice of partial utilization, the OWNER's REPRESENTATIVE will deliver to the OWNER and the CONTRACTOR a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities and insurance.

C. The CONTRACTOR shall retain full responsibility for satisfactory completion of the WORK, regardless of whether a portion thereof has been partially utilized by the OWNER, and the CONTRACTOR's one-year correction period shall commence only after the date of Final Completion for the WORK.

14.07 DAMAGES

A. The CONTRACTOR shall pay to the OWNER the amount specified in the Supplementary General Conditions, not as a penalty but as liquidated damages, if he fails to complete the WORK or specified parts of the WORK within the Contract Time. The periods for which these damages shall be paid shall be the number of Days from the Contract Time as contained in the Agreement, or from the date of termination of any extension of time approved by the OWNER, to the date or dates on which the OWNER issues the Notice of Substantial Completion as provided in Article 14.08, herein. The OWNER may deduct the amount of said damages from any monies due or to become due the CONTRACTOR. After Substantial Completion, if the CONTRACTOR fails to complete the remaining WORK within 45 days or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER the amount stated in the Supplementary General Conditions as liquidated damages for each day that expires after the 45 days, until readiness for final payment.

B. The said amount is fixed and agreed upon by and between the CONTRACTOR and the OWNER because of the impracticability and extreme difficulty of fixing and ascertaining the actual damages the OWNER would sustain; and said amount is agreed to be the amount of damages which the OWNER would sustain.

C. If actual damages are assessed, they will include all costs incurred by the OWNER as a result of a delay in the completion time of the work beyond the contract time.

D. All times specified in the Contract Documents are hereby declared to be of the essence.

14.08 SUBSTANTIAL COMPLETION

A. When the CONTRACTOR considers the WORK ready for its intended use, the CONTRACTOR will notify the OWNER in writing that the WORK is Substantially Complete. Within a reasonable time thereafter, the OWNER and the CONTRACTOR, shall make an inspection of the WORK to determine the status of completion. If the OWNER does not consider the WORK Substantially Complete, the OWNER will notify the CONTRACTOR in writing giving the reasons therefor. If the OWNER considers the WORK Substantially Complete, the OWNER will execute the Notice of Substantial Completion signed by the CONTRACTOR, which shall fix the date of Substantial Completion.

B. The Notice of Substantial Completion shall be a release by the CONTRACTOR of the OWNER and its agents from all claims and liability to the CONTRACTOR for anything done or furnished for, or relating to, the WORK or for any act or neglect of the OWNER or of any person relating to or affecting the WORK, to the date of Substantial Completion, except demands against the OWNER for the remainder of the amounts kept or retained from progress payments and excepting pending, unresolved claims filed in writing prior to the date of Substantial Completion. At the time of delivery of the Notice of Substantial Completion, the OWNER’s REPRESENTATIVE will deliver to the OWNER and the CONTRACTOR, if applicable, a written recommendation as to division of responsibilities between the OWNER and the CONTRACTOR with respect to security, operation, safety, maintenance, heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the recommendation will be binding on the OWNER and the CONTRACTOR until final payment.

C. The OWNER, upon written notice to the CONTRACTOR, shall have the right to exclude the CONTRACTOR from the WORK after the date of Substantial Completion, and complete all or portions of the WORK at the CONTRACTOR's expense.

14.09 COMPLETION AND FINAL PAYMENT

A. Upon written certification from the CONTRACTOR that the WORK is complete (if a Notice of Substantial Completion has been issued this certification must occur within 45 days of that date), the OWNER will make a final inspection with the CONTRACTOR. If the OWNER does not consider the WORK complete, the OWNER will notify the CONTRACTOR in writing of all particulars in which this inspection reveals that the WORK is incomplete or defective. The CONTRACTOR shall immediately take the measures necessary to remedy these deficiencies. If the OWNER considers the WORK complete, the CONTRACTOR may proceed to file its application for final payment pursuant to this Article. At the request of the CONTRACTOR, the OWNER's REPRESENTATIVE may recommend to the OWNER that certain minor deficiencies in the WORK that do not prevent the entire WORK from being used by the OWNER for its intended use, and the completion of which will be unavoidably delayed due to no fault of the CONTRACTOR, be exempted from being completed prerequisite to final payment. These outstanding items of pickup work, or "punch list items", shall be listed on the Notice of Substantial Completion, together with the recommended time limits for their completion, and extended warranty requirements for those items and the value of such items.

B. After the issuance of the Notice of Completion and after the CONTRACTOR has completed corrections that have not been exempted to the satisfaction of the OWNER and delivered to the OWNER all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, marked-up record documents and other documents, all as required by the Contract Documents; and after the OWNER has indicated that the WORK is acceptable, the CONTRACTOR may make application for final payment following the procedure for progress payments. The final application for payment shall be accompanied by all documentation called for in the Contract Documents and other data and schedules as the OWNER may reasonably require, including an affidavit of the CONTRACTOR that all labor, services, material, equipment and other indebtedness connected with the WORK for which the OWNER or his property might in any way be responsible, have been paid or otherwise satisfied, and a consent of the payment bond surety to final payment, all in forms approved by the OWNER.

14.10 FINAL APPLICATION FOR PAYMENT

A. If, on the basis of the OWNER's observation of the WORK during construction and final inspection, and the OWNER's review of the final application for payment and accompanying documentation, all as required by the Contract Documents, the OWNER is satisfied that the WORK has been completed and the CONTRACTOR has fulfilled all of his obligations under the Contract Documents, the OWNER's REPRESENTATIVE will, within ten days after receipt of the final application for payment, indicate in writing his recommendation of payment and present the application to the OWNER for payment. Thereupon, the OWNER's REPRESENTATIVE will give written notice to the OWNER and the CONTRACTOR that the WORK is acceptable by executing the Notice of Completion. Otherwise, the OWNER will return the application to the CONTRACTOR, indicating in writing the reasons for refusing to recommend final payment, in which case the CONTRACTOR shall make the necessary corrections and resubmit the application.

B. Within 45 calendar days after the Notice of Completion, the OWNER will make final payment including all deducted retainage and interest to the CONTRACTOR. The OWNER's remittance of final payment shall be the OWNER's acceptance of the WORK if formal acceptance of the WORK is not indicated otherwise. The final payment shall be that amount remaining after deducting all prior payments and all amounts to be kept or retained under the provisions of the Contract, including the following items:

1. Liquidated or actual damages, as applicable.

2. Two times the value of any outstanding items of pickup work or "punch list items", indicated on the OWNER's Notice of Completion as being yet uncompleted.

14.11 CONTRACTOR'S CONTINUING OBLIGATIONS

A. The CONTRACTOR's obligation to perform and complete the WORK in accordance with the Contract Documents shall be absolute. Neither recommendation of any progress or final payment by the OWNER, nor the issuance of a Notice of Substantial Completion or Notice of Completion, nor payment by the OWNER to the CONTRACTOR under the Contract Documents, nor any use or occupancy of the WORK or any part thereof by the OWNER, nor any act of acceptance by the OWNER nor any failure to do so, nor any review of a shop drawing or sample submittal, will constitute an acceptance of work or materials not in accordance with the Contract Documents or a release of the CONTRACTOR's obligation to perform the WORK in accordance with the Contract Documents.

14.12 FINAL PAYMENT TERMINATES LIABILITY OF OWNER

A. Final payment is defined as the last progress payment made to the CONTRACTOR for earned funds, less deductions listed in Paragraph 14.10B herein. The acceptance by the CONTRACTOR of the final payment referred to in Paragraph 14.10 herein, shall be a release of the OWNER and its agents from all claims of liability to the CONTRACTOR for anything done or furnished for, or relating to, the work or for any act or neglect of the OWNER or of any person relating to or affecting the work, except demands against the OWNER for the remainder, if any, of the amounts kept or retained under the provisions of Paragraph 14.10 herein; and excepting pending, unresolved claims filed prior to the date of the Notice of Substantial Completion.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 SUSPENSION OF WORK BY OWNER

A. The OWNER may, by written notice to the Contractor, temporarily suspend the WORK, in whole or in part, for a period or periods of time, but not to exceed 90 days, for the convenience and benefit of the OWNER upon the occurrence of any one or more of the following: (1) unsuitable weather; (2) delay in delivery of OWNER- furnished equipment or materials, or such other conditions as are considered unfavorable for prosecution of the work; (3) Shortfall in construction funds; (4) Constraints imposed by public entities, public utilities, property owners or legal proceedings; (5) Failure or delay in acquisition of easements or right-of-way by the OWNER; or (6) Other conditions which, in the opinion of the OWNER, warrant a delay in the WORK. Suspended WORK shall be resumed by the CONTRACTOR within 10 calendar days of receipt from the OWNER of written notice to

resume work. Whenever the OWNER temporarily suspends work for any conditions enumerated in this Article, the CONTRACTOR shall be entitled to an adjustment in the Contract Time as specified in Article 12.03 C.

B. The suspension of work shall be effective upon receipt by the CONTRACTOR of a written order suspending the work and shall be terminated upon receipt by the Contractor of a written order terminating the suspension.

C. The CONTRACTOR hereby indemnifies and holds harmless the OWNER, their officers, agents and employees, from and against all claims, damages, losses and expenses, including lost profits and attorney's fees, arising out of or resulting from the temporary suspension of the WORK, whether for the OWNER's convenience described in this Article or for whatever other reasons, including the stoppage of work by the OWNER for the CONTRACTOR's failure to comply with any order issued by the OWNER.

15.02 TERMINATION OF AGREEMENT BY OWNER (CONTRACTOR DEFAULT)

A. In the event of default by the CONTRACTOR, the OWNER may give written notice to the CONTRACTOR of OWNER's intent to terminate the Agreement. The notice shall state the event of default and the time allowed to remedy the default. It shall be considered a default by the CONTRACTOR whenever the CONTRACTOR shall: (1) declare bankruptcy, become insolvent, or assign its assets for the benefit of its creditors; (2) fail to provide materials or workmanship meeting the requirements of the Contract Documents; (3) disregard or violate provisions of the Contract Documents or OWNER’s instructions, (4) fail to prosecute the WORK according to the approved progress schedule; or, (5) fail to provide a qualified superintendent, competent workmen, or materials or equipment meeting the requirements of the Contract Documents. If the CONTRACTOR fails to remedy the conditions constituting default within the time allowed, the OWNER may then issue a Notice of Termination.

B. In the event the Agreement is terminated in accordance with Paragraph 15.02A, the OWNER may take possession of the WORK and may complete the WORK by whatever method or means the OWNER may select. The cost of completing the WORK shall be deducted from the balance which would have been due the CONTRACTOR had the Agreement not been terminated and the WORK completed in accordance with the Contract Documents. If such cost exceeds the balance which would have been due, the CONTRACTOR shall pay the excess amount to the OWNER. If such cost is less than the balance which would have been due, the CONTRACTOR shall have no claim to the difference.

15.03 TERMINATION OF AGREEMENT BY OWNER (FOR CONVENIENCE)

A. The OWNER may terminate the Agreement at any time if it is found that reasons beyond the control of either the OWNER or CONTRACTOR make it impossible or against the OWNER's interests to complete the WORK. In such a case, the CONTRACTOR shall have no claims against the OWNER except: (1) for the value of the work, as determined by the OWNER, performed by the Contractor up to the date the Agreement is terminated; and, (2) for the cost of materials and equipment on hand, in transit, or on definite commitment, as of the date the Agreement is terminated, which would be needed in the WORK and which meet the requirements of the Contract Documents. The value of work performed and the cost of materials and equipment delivered to the site, as mentioned

above, shall be determined by the OWNER in accordance with the procedure prescribed from making the final application for payment and final payment under Paragraphs 14.09 and 14.10.

15.04 TERMINATION OF AGREEMENT BY CONTRACTOR

A. The CONTRACTOR may terminate the Agreement upon 10 days written notice to the OWNER, whenever: (1) the WORK has been suspended under the provisions of Paragraph 15.01, for more than 90 consecutive days through no fault or negligence of the CONTRACTOR, and notice to resume work or to terminate the agreement has not been received from the OWNER within this time period; or, (2) the OWNER should fail to pay the CONTRACTOR any monies due him in accordance with the terms of the Contract Documents and within 60 days after presentation to the OWNER by the CONTRACTOR of a request therefore, unless within said 10-day period the OWNER shall have remedied the condition upon which the payment delay was based. In the event of such termination, the CONTRACTOR shall have no claims against the OWNER except for those claims specifically enumerated in Paragraph 15.03, and as determined in accordance with the requirements of that paragraph.

ARTICLE 16 – NOTICE

16.01 GIVING NOTICE

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

16.02 TITLE TO MATERIALS FOUND ON THE WORK

A. The OWNER reserves the right to retain title to all soils, stone, sand, gravel, and other materials developed and obtained from excavations and other operations connected with the WORK. Unless otherwise specified in the Contract Documents, neither the CONTRACTOR nor any Subcontractor shall have any right, title, or interest in or to any such materials. The CONTRACTOR will be permitted to use in the WORK, without charge, any such materials which meet the requirements of the Contract Documents.

16.03 RIGHT TO AUDIT

A. If the CONTRACTOR submits a claim to the OWNER for additional compensation, the OWNER shall have the right, as a condition to considering the claim, and as a basis for evaluation of the claim, and until the claim has been settled, to audit the CONTRACTOR's books. This right shall include the right to examine books, records, documents, and other evidence and accounting procedures and practices, sufficient to discover and verify all direct and indirect costs of whatever nature claimed to have been incurred or anticipated to be incurred and for which the claim has been submitted. The right to audit shall include the right to inspect the CONTRACTOR's plants, or such parts thereof, as may be or have been engaged in the performance of the WORK. The CONTRACTOR further agrees that the right to audit encompasses all subcontracts and is binding upon subcontractors. The right to examine and inspect herein provided for shall be exercisable through such

representatives as the OWNER deems desirable during the CONTRACTOR's normal business hours at the office of the CONTRACTOR. The CONTRACTOR shall make available to the OWNER for auditing, all relevant accounting records and documents, and other financial data, and upon request, shall submit true copies of requested records to the OWNER.

16.04 HAZARDOUS MATERIALS

A. If the CONTRACTOR during the course of work observes the existence of hazardous material, the CONTRACTOR shall promptly notify the OWNER. The OWNER shall consult with others regarding removal or encapsulation of the hazardous material and the CONTRACTOR shall not perform any work pertinent to the hazardous material prior to receipt or special instruction from the OWNER.

ARTICLE 17 – SUBCONTRACT LIMITATIONS

17.01 SUBCONTRACT LIMITATIONS

A. In addition to the provisions of Paragraph 6.05 of the General Conditions, the CONTRACTOR shall perform not less than 30 percent of the WORK with its own forces (i.e., without subcontracting). The 30 percent requirement shall be understood to refer to the WORK, the value of which totals not less than 30 percent of the Contract Price.

ARTICLE 18 – PATENTS AND COPYRIGHTS

18.01 PATENTS AND COPYRIGHTS

A. The CONTRACTOR shall indemnify and save harmless the OWNER, the ENGINEER, and their officers, agents, and employees, against all claims or liability arising from the use of any patented or copyrighted design, device, material, or process by the CONTRACTOR or any of his subcontractors in the performance of the WORK.

-END OF SECTION-

SECTION 00800
SUPPLEMENTARY GENERAL CONDITIONS

PART 1 – GENERAL

These Supplementary General Conditions make additions, deletions, or revisions to the General Conditions as indicated herein. All provisions which are not so added, deleted, or revised remain in full force and effect. Terms used in these Supplementary General Conditions which are defined in the General Conditions have the meanings assigned to them in the General Conditions.

SGC-1 DEFINITIONS

Add the following definitions to Article 1:

OWNER – The OWNER is further defined as South Valley Water Reclamation Facility, 7495 South 1300 West, West Jordan, Utah 84084. Telephone No.: (801) 566-7711.

OWNER'S REPRESENTATIVE – The OWNER'S REPRESENTATIVE is defined in SGC – 9.03 on page 00800-5. The OWNER'S REPRESENTATIVE for this project shall be Taigon Worthen.

BIDDER – The person, firm, or corporation, partnership or joint venture or LLC submitting a Bid for the Work.

CONTRACTOR – The person, firm, or corporation, partnership or joint venture or LLC with whom the OWNER has executed the Agreement.

ENGINEER – Defined as the firm of Carollo Engineers, Inc., located at 10822 W. Toller Drive, Littleton, CO 80127.

SGC-4.02 REPORTS OF PHYSICAL CONDITIONS

In the preparation of the Contract Documents, the OWNER has relied upon:

A. The following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground utilities) which are at or contiguous to the site of the WORK.

1. Drawings dated May 28, 1982, prepared by James M. Montgomery, Consulting Engineers, Inc. entitled "SVWRF – Project 2A."

2. Drawings dated May 8, 1984, prepared by James M. Montgomery, Consulting Engineers, Inc. entitled "SVWRF - Project 2B."

3. Drawings dated January 23, 1992, prepared by James M. Montgomery, Consulting Engineers, Inc. entitled "SVWRF – Project 3."

4. Drawings dated January 2006 prepared by James M. Montgomery, Consulting Engineers, Inc., entitled "SVWRF – Project 4C."

5. Drawings dated January 2008 prepared by Bowen Collins & Associates, Inc., entitled “SVWRF – Project 4D.”

5. Drawings dated November 2011 prepared by Carollo Engineers entitled “2011 Headworks VFD Replacement”.

6. Drawings dated January 2022 prepared by Carollo Engineers entitled “Project 5.”

7. Drawings dated July 2023 prepared by Carollo Engineers entitled “2023 VFD Replacement Project.”

B. Copies of these drawings may be examined at the office of the OWNER, during regular business hours. As provided in Paragraph 4.02 of the General Conditions and as identified and established above, the CONTRACTOR may rely upon the accuracy of the technical data contained in such reports and drawings, except for such physical dimensions that can be field verified; however, the interpretation of such technical data, including any interpolation or extrapolation thereof, and opinions contained in such reports and drawings are not to be relied on by the CONTRACTOR.

SGC-5.01 BONDS

Delete the first sentence of Paragraph 5.1A and add the following:

The CONTRACTOR shall furnish a satisfactory Performance Bond in the amount of 100 percent of the Contract Price and a satisfactory Payment Bond in the amount of 100 percent of the Contract Price as security for the faithful performance and payment of all the CONTRACTOR’s obligations under the Contract Documents.

SGC-5.02 INSURANCE

A. Substitute for Paragraph 5.02.B. the following:

All insurance required by the Contract Documents to be purchased and maintained by the CONTRACTOR shall be obtained from insurance companies that are duly licensed, admitted, and authorized to issue insurance policies for the limits and coverage so required in the State in which the Project is located. Such insurance companies shall have a current Best’s Rating of at least an “A” (Excellent) general policy holder’s rating and a Class VIII financial size category and shall also meet such additional requirements and qualifications as may be provided in the Supplementary General Conditions.

B. Add the following to Paragraph 5.02.B.5:

If the OWNER finds it necessary to occupy or use a portion or portions of the project prior to Substantial Completion, the OWNER shall provide notice of occupancy without the need for mutual agreement between the OWNER and the CONTRACTOR and to which the insurance company providing the Builder’s Risk Insurance has consented by endorsement to the policy or policies.

C. The limits of liability for the insurance required by Paragraph 5.2 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations. Limits may be provided by a combination of primary and excess liability policies or through a single policy. If the limits are provided by a combination of primary and excess liability policies, then the excess or umbrella liability coverages shall include commercial general, comprehensive automobile, and employer's liability and shall provide coverage at least as broad as the underlying policies.

1. Workers' Compensation:

a.	State:	Statutory
b.	Applicable Federal (e.g. USHL&H):	Statutory
c.	Employer's Liability:	$1,000,000

2. Comprehensive or Commercial General Liability:

Combined Single Limit:

a. Premises/operations

$ 1,000,000	Each Occurrence
$ 2,000,000	Annual Aggregate

b. Products/completed operations

$ 1,000,000	Each Occurrence
$ 2,000,000	Annual Aggregate

c. Personal Injury

$ 1,000,000	Each Occurrence
$ 2,000,000	Annual Aggregate

d. Policies shall include premises/operations, products, completed operations, independent contractors, owners' and contractors' protective, explosion, collapse, underground hazards, broad form contractual, personal injury with employment contractual exclusions deleted, and broad form property damage.

e. If policies are written on a Commercial General Liability form, the General Aggregate shall be at least two times the each occurrence limit or be written on a "per project" basis.

f. All policies shall be written on an occurrence basis. If the CONTRACTOR would like to substitute any "claims made" liability policies, then these must be pre-approved in writing according to the terms and conditions they may impose.

g. If policies are written for split limits, limits shall be equal for bodily injury and property damage liability.

3. Comprehensive Automobile Liability (including owned, hired, and non-owned vehicles):

   Combined Single Limit:

   a. Bodily Injury and Property Damage: $2,000,000 each accident

   b. If policies are written for split limits, limits shall be equal for bodily injury per person, bodily injury per accident and property damage.

4. Excess Liability Insurance:

   a. $4,000,000 over all underlying coverage lines

5. Builder's Risk Insurance:

   a. In an amount equal to the replacement cost of the completed value of the project or $4,000,000 whichever is greater.

   b. Any deductibles of self-insured retentions shall be as agreed to by the OWNER and CONTRACTOR.

   c. The CONTRACTOR shall include flood and earthquake coverage in the Builder's Risk Insurance requirements under Paragraph 5.02.B.5 of the General Conditions, with a minimum limit of $4,000,000 per event or occurrence.

D. All policies shall provide that the CONTRACTOR agrees to waive all rights of subrogation against the OWNER, the ENGINEER, and their subconsultants, employees, officers and directors, for WORK performed under the Agreement. Endorsements shall be provided with certificates of insurance.

E. All policies shall also specify that the insurance provided by the CONTRACTOR will be considered primary and not contributory to another insurance available to the OWNER or ENGINEER.

F. All policies except Workers' Compensation and Builders Risk shall name the OWNER, including their officers, directors or board members, employees agents or any others associated with the management or operations of South Valley Water Reclamation Facility; Engineer, their consultants, subconsultants, shall be additional insureds on the Auto Liability and Commercial General Liability policies. The Builders Risk insurance shall name the CONTRACTOR, OWNER, and ENGINEER as named insureds and subcontractors and additional insureds. The Workers' Compensation policy shall name the OWNER as additional insured by means of an alternative employer endorsement, with respect to the employer's liability coverage only.

G. All policies shall provide for 60 days notice prior to any cancellation, reduction in coverage or nonrenewal.

H. The deductible or self-insured retention on Comprehensive or Commercial General Liability shall not be greater than $25,000. All deductibles are the responsibility of the CONTRACTOR.

SGC-6.05 SUBCONTRACT LIMITATIONS

Add the following as paragraph 6.05.B of the General Conditions

B. The CONTRACTOR shall perform not less than 30 percent of the WORK with its own forces (i.e., without subcontracting). The 30 percent requirement shall be understood to refer to the WORK, the value of which totals not less than 30 percent of the Contract Price.

SGC-6.06 PERMITS

A. The CONTRACTOR shall acquire and comply with the following permits if applicable:

1. State permits to construct and/or operate sources of air pollution.

2. Certificates and permits are required for sources such as, but not limited to, the following:

   a. Fuel burning equipment
   b. Gasoline and petroleum distillate storage containers
   c. Land disturbing activities
   d. Processing equipment (sand, gravel, concrete batch plant, etc.)
   e. Odors.

3. Permit-Required Confined Space: The workspace in which the WORK is to be performed may contain permit-required confined spaces (permit spaces) as defined in 29 CFR 1910.146. Permit space entry is allowed in such spaces only through compliance with a confined space entry program meeting the requirements of 29 CFR 1910.146.

4. Encroachment Permit

B. The CONTRACTOR shall comply with OWNER requirements for a “Hot Work Permit” as described in Section 01520 – Security/Process Safety Management.

SGC-9.03 PROJECT REPRESENTATION

A. The OWNER’s Representative, will act as directed by and under the supervision of the OWNER and will confer with the OWNER regarding its actions. The OWNER’s REPRESENTATIVE dealings in matters pertaining to the WORK shall, in general, be only with the OWNER and the CONTRACTOR, and dealings with Subcontractors shall only be through or with the full knowledge of the CONTRACTOR.

B. The OWNER's REPRESENTATIVE shall have the duties and responsibilities set forth in this paragraph.

1. Review the progress schedule of Shop Drawing submittals and schedule of values prepared by the CONTRACTOR and consult with the ENGINEER concerning their acceptability, as applicable.

2. Attend preconstruction conferences. Arrange a schedule of progress meetings and other job conferences as required and notify in advance those expected to attend.
Attend meetings and maintain and circulate copies of minutes thereof.

3. Serve as the OWNER's liaison with the CONTRACTOR, working principally through the CONTRACTOR's superintendent and assist said superintendent in understanding the intent of the Contract Documents.

4. Receive Shop Drawings and samples furnished by the CONTRACTOR.

5. Conduct on-site observations of the WORK in progress to assist the OWNER in determining if the WORK is proceeding in accordance with the Contract Documents.

6. Transmit to the CONTRACTOR the OWNER's or ENGINEER's clarifications and interpretations of the Contract Documents.

7. Consider and evaluate the CONTRACTOR's suggestions for modifications in the Contract Documents and report them with recommendations to the OWNER.

8. Review applications for payment with the CONTRACTOR for compliance with the established procedure for their submittal and forward them with recommendations to the OWNER, noting particularly their relation to the schedule of values, work completed, and materials and equipment delivered at the Site but not incorporated in the WORK.

9. During the course of the WORK, verify that certificates, maintenance and operation manuals, and other data required to be assembled and furnished by the CONTRACTOR are applicable to the items actually installed.

10. Before the OWNER prepares a Notice of Completion, as applicable, submit to the CONTRACTOR a list of observed items requiring completion or correction.

11. Conduct final inspection in the company of the ENGINEER, the OWNER, and the CONTRACTOR, and prepare a punch list of items to be completed or corrected.

12. Verify that all items on the punch list have been completed or corrected and make recommendations concerning acceptance.

SGC-11.03D EQUIPMENT

The CONTRACTOR will be paid for the use of equipment at the rental rate listed for such equipment specified in the current edition of the following reference publication:

A. "Rental Rate Blue Book for Construction Machinery" as published by the Machinery Information Division of the K-III Directory Corporation, telephone number (800) 669-3282.

SGC-12.02 WEATHER DELAYS

The CONTRACTOR's construction schedule shall anticipate 30 days of delay due to unusually severe weather.

SGC-14.03C AMOUNT OF RETENTION

Add the following to Paragraph 14.03C of the General Conditions:

Unless otherwise prescribed by law, the OWNER may retain a portion of the amount otherwise due to the CONTRACTOR, as follows:

1. Retention of 5 percent of each approved progress payment until the WORK is certified as having reached substantial completion.

SGC-14.03D VALUE OF MATERIALS STORED AT THE SITE

Unless otherwise prescribed by law or prescribed in Assigned Purchase Order Agreements, the value of materials stored at the SVWRF shall be 95 percent of the value of such materials.

SGC-14.05.A REVIEW OF APPLICATIONS FOR PROGRESS PAYMENT

Replace the last sentence with the following: "Forty-Five days after presentation of the Application for Payment with the ENGINEER'S recommendation, the amount recommended will (subject to the provisions of Paragraph 14.05B) become due and when due will be paid by the OWNER to the CONTRACTOR."

SGC-14.07.A DAMAGES

Add the following sentence: "The amount of liquidated damages shall be $1000 per calendar day."

-END OF SECTION-

SECTION 00810
SUPPLEMENTARY GENERAL CONDITIONS (UTAH)

SGC-18 UTAH STATE REQUIREMENTS

A. Retainage of Compensation to CONTRACTOR: Pursuant to Utah Code Ann. 13-8-5, any retainage of CONTRACTOR's compensation hereunder shall be placed in an interest-bearing escrow account and the interest which accrues thereon shall do so for the benefit of CONTRACTOR and Subcontractors. Release of the retainage shall be as contemplated by the General Conditions and Supplementary General Conditions, Article 14 – Payments to Contractor, Liquidated Damages and Completion. Any interest which has accrued on the retainage and which is released to the CONTRACTOR shall be promptly disbursed by CONTRACTOR to itself and/or to Subcontractors on a pro rata basis.

B. Certification of Change Orders: Pursuant to Utah Code Ann. Section 63G-6-602, no change order shall be authorized without a written certification, signed by an official representative of the OWNER responsible for monitoring and reporting the status of the costs of the total Project or the contract budget, stating that funds are available for the subject change order.

C. Adjustments in Price: Pursuant to Utah Code Ann. Section 63G-6-601, any adjustment in compensation due CONTRACTOR under this agreement shall be computed in one or more of the following ways:

1. By agreement on a fixed-price adjustment before commencement of the pertinent performance or as soon as practicable;

2. By unit prices specified in the contract or subsequently agreed upon;

3. By the costs attributable to the events or situations with adjustment of profit or fee, all as specified in the contract or subsequently agreed upon;

4. In any other manner as OWNER and CONTRACTOR may mutually agree;

5. In the absence of agreement between CONTRACTOR and OWNER, by a unilateral determination by OWNER of the costs attributable to the events or situations with adjustment of profit or fee, all as computed by the OWNER in accordance with Utah Code Ann. Section 63G-6-415 and/or the rules and regulations promulgated thereunder.

D. Cost Principles: CONTRACTOR shall comply in all respects with applicable provisions of Utah Code Ann. Section 63G-6-415, and the rules and regulations promulgated thereunder. To the extent that such provisions are inconsistent with the other terms and conditions of this agreement, the former shall prevail. OWNER may, at reasonable times and places, audit the books and records of CONTRACTOR, any Subcontractor, or any other person who has submitted cost or pricing data pursuant to said section. The books and records of CONTRACTOR shall be maintained for 3 years following the end of the fiscal year in which final payment is made under the Contract. The books and records of the Subcontractor and all other persons shall be maintained for 3 years following the end of the fiscal year in which final payment is made under the subcontract and/or to the person, unless a shorter period is otherwise authorized in writing.

E. Project Safety: CONTRACTOR shall comply in all respects with the Utah Occupational Safety and Health Act, Utah Code Ann. Sections 34A-6-101 et seq., and the rules, regulations and standards promulgated thereunder by the Utah State Industrial Commission, as such act, rules, regulations or standards now exist or may be amended during the term of this agreement. Specifically, but not in limitation, CONTRACTOR shall comply with Construction Standards, Rules and Regulations, promulgated by the Utah Occupation and Safety and Health Division, Utah State Industrial Commission.

F. Protection of Underground Utility Facilities: CONTRACTOR shall comply in all respects with Utah Code Ann. Section 54 Chapter 8a et seq. and the rules and regulations promulgated thereunder, as it now exists or may be amended during the term of this agreement, with regard to the protection of underground utility facilities. Specifically, but not in limitation, CONTRACTOR shall notify the appropriate public utility(s) when making an excavation with power equipment. CONTRACTOR shall further refrain from proceeding with excavation until such time as the appropriate public utility(s) have advised CONTRACTOR of the location of any underground facilities in the area proposed for excavation by marking such facilities with stakes, paint, or other customary way, indicating horizontal location within 24 inches of the outside dimensions of both sides of the underground facility.

G. Review of Construction by OWNER: OWNER may, at its option, assign a field representative to review the construction of the Project in progress. Said representative will cooperate with the ENGINEER/OWNER in attempting to note deviations from, or necessary adjustments to, the Contract Documents or deficiencies or defects in the construction. Said representative's presence on the Project, however, shall in no way relieve CONTRACTOR of its primary responsibility for construction of the Project in accordance with the Contract Documents.

H. OWNER Inspection: Pursuant to Utah Code Ann. Section 63G-6-418, OWNER may, at reasonable times, inspect the plant or place of business of the CONTRACTOR or any Subcontractor which is related to the performance of this contract or any subcontract entered into hereunder.

I. Code Requirements: The provisions of the latest editions of the International Building Code, National Electric Code, and Utah Plumbing Code, as adopted or followed in Utah, including standards adopted in relation thereto, as supplemented or amended, shall apply to the Project except as specific variances may be expressly authorized by the OWNER. If the Contract Documents fail to meet the minimum standards of the referenced codes, CONTRACTOR shall be responsible to bring such information to the attention of the architect/OWNER associated with the Project. Subcontractors shall also inform CONTRACTOR of any infractions of the above-referenced codes regarding their own particular trades. In the event that workmanship or incidental materials are not specified or indicated, they shall at least conform to the above-referenced codes and shall be incorporated into the Work without any additional cost to the OWNER. If the Contract Documents call for items or workmanship which exceed code requirements, the Contract Documents shall take precedence over such requirements.

J. Workers Compensation: CONTRACTOR shall comply in all respects with Utah Code Ann. Section 34A-2-101, et seq. and the rules and regulations promulgated thereunder by the Utah State Industrial Commission, as such law, rules or regulations now exist or may be amended during the term of this agreement.

K. Archaeological, Anthropological, or Paleontological Findings: CONTRACTOR shall comply with Utah Code Ann. Section 9-8-301 et seq., with respect to the discovery of archaeological, anthropological, or paleontological findings at or on the Project site. Specifically, but not in limitation, CONTRACTOR shall promptly notify the Utah Division of State History of any such findings.

L. Nondiscrimination Equal Employment Opportunity: CONTRACTOR shall comply in all respects with the Utah Anti-Discrimination Act of 1965, Utah Code Ann. Section 34A-5-101 et seq., and the rules and regulations promulgated thereunder by the Utah State Industrial Commission and/or its Anti-Discrimination Division, as such act, rules or regulations now exist or may be amended during the term of this agreement, specifically:

1. CONTRACTOR shall not discriminate against any employee or applicant for employment because of race, color, sex, religion, ancestry or national origin.

2. In all solicitations or advertisements for employees, CONTRACTOR shall state that all qualified applicants shall receive consideration without regard to race, color, sex, religion, ancestry or national origin.

3. CONTRACTOR shall send to each labor union or worker's representative notices to be provided, stating the CONTRACTOR's responsibilities under the statute.

4. CONTRACTOR shall furnish such information or reports as are requested by the Utah State Industrial Commission and/or its Anti-Discrimination Division, for the purpose of determining compliance with the statute.

5. CONTRACTOR shall include the provisions of paragraphs 1 through 4 above in all subcontracts for this Project.

6. Failure of the CONTRACTOR to comply with the statute, the rules and regulations promulgated thereunder, and this provision, shall be deemed a breach of contract entitling OWNER, in its discretion, to cancel, terminate, or suspend this agreement in whole or in part.

M. Affirmative Action: CONTRACTOR shall take affirmative action to insure that applicants are employed and that employees are treated during employment without regard to their race, color, religion, sex or national origin. Such action shall include, but shall not be limited to: employment; upgrading; demotion or transfer; recruitment or recruitment advertising; layout or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship.

At its discretion, OWNER may perform a compliance review at CONTRACTOR's place of business and/or the Project site to verify CONTRACTOR's compliance with this provision. Such compliance verifications may be conducted with such frequency as is needed to assure CONTRACTOR's compliance with this provision.

N. Citizens Preferred: Pursuant to Utah Code Ann. Section 34-30-1, CONTRACTOR shall give preference in hiring to citizens of the United States or those having declared their intention to become citizens; failure to comply may render this contract null and void at the discretion of OWNER.

O. Veterans' Preference: Pursuant to Utah Code Ann. Section 71-10-2, CONTRACTOR shall give preference in hiring to honorable discharged veterans who have served in the Armed Forces of the United States during a period of conflict, war, or other national emergencies as defined by Congress, and to any un-remarried surviving spouse of an honorably discharged veteran, if they possess qualifications for that employment and if the honorably discharged veteran is or, if deceased, was a resident of the State of Utah.

P. Specific OWNER Requirements: CONTRACTOR shall comply with the specific rules and regulations promulgated by OWNER pursuant to authority granted or retained under the Utah Procurement Code, Utah Code Ann. Section 63G-6-101, et seq.

-END OF SECTION-

DOCUMENT 00940

WORK CHANGE DIRECTIVE

Owner:	South Valley Water Reclamation Facility	Owner's Project No.:
Engineer:	Carollo Engineers, Inc.	Engineer's Project No.:
Contractor:		Contractor's Project No.:
Project:		
Contract Name:		
Date Issued:		Effective Date of Work Change Directive:

Contractor is directed to proceed promptly with the following change(s):

Description:

[Description of the change to the Work]

Attachments:

[List documents related to the change to the Work]

Purpose for the Work Change Directive:

[Describe the purpose for the change to the Work]

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Notes to User—Check one or both of the following

☐ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price:	$ _____	**[increase][decrease][not yet estimated]**.
Contract Time:	_____ days	**[increase][decrease][not yet estimated]**.

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

	Recommended by Engineer	Authorized by Owner
By:		
Title:		
Date:		

END OF DOCUMENT

DOCUMENT 00941

CHANGE ORDER

Owner:	South Valley Water Reclamation Facility	Owner's Project No.:	
Engineer:	Carollo Engineers, Inc.	Engineer's Project No.:	202633
Contractor:		Contractor's Project No.:	
Project: Contract Name:			
Date Issued:		Effective Date of Change Order:	

The Contract is modified as follows upon execution of this Change Order:

Description:

[Description of the change]

Attachments:

[List documents related to the change]

In signing a Change Order, the Owner and Contractor acknowledge and agree that:

1. The Change Order constitutes full mutual accord and satisfaction for the change to the Work. 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.
2. This Change Order will become a supplement to the Contract and all Contract provisions will apply hereto.
3. It is understood that this Change Order shall be effective on the date the Owner authorizes the Change Order by their signature.
4. No reservation of rights to pursue subsequent claims on the Change Order will be made by either party.
5. No subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.

Change in Contract Price	Change in Contract Times [State Contract Times as either a specific date or a number of days]
Original Contract Price: $ _____	Original Contract Times: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. **[Number of previous Change Order]**: $ _____	**[Increase] [Decrease]** from previously approved Change Orders No. 1 to No. **[Number of previous Change Order]**: Substantial Completion: _____ Ready for final payment: _____
Contract Price prior to this Change Order: $ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] this Change Order: $ _____	**[Increase] [Decrease]** this Change Order: Substantial Completion: _____ Ready for final payment: _____
Contract Price incorporating this Change Order: $ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for final payment: _____

Recommended by Engineer (if required)	Authorized by Owner
By: _____	_____
Title: _____	_____
Date: _____	_____
Authorized by Contractor	**Approved by Funding Agency (if applicable)**
_____	_____
By: _____	_____
Title: _____	_____
Date: _____	_____

END OF DOCUMENT

DOCUMENT 00942

FIELD ORDER

Owner:	South Valley Water Reclamation Facility	Owner's Project No.:
Engineer:	Carollo Engineers, Inc.	Engineer's Project No.:
Contractor:		Contractor's Project No.:
Project: Contract Name:		
Date Issued:		Effective Date of Field Order:

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:

[Description of the change to the Work]

Attachments:

[List documents supporting change]

Issued by Engineer

By: _____

Title: _____

Date: _____

END OF DOCUMENT

SECTION 01030

SPECIAL PROJECT CONSTRAINTS

PART 1 GENERAL

1.01 SUMMARY

A. Work involved with existing plant:
   1. The Work shall be executed while the existing wastewater treatment plant is in operation. Operation of the existing plant shall not be jeopardized, nor shall the efficiency of wastewater treatment be reduced as a result of the execution of the Work.
   2. Critical events in the sequence of construction are described in this Section and shall be utilized by the Contractor as a guideline.

1.02 COMPLIANCE WITH UPDES PERMIT

A. Operations by the Contractor shall not impair in any way the Owner's responsibility to comply with the facility's UPDES permit requirements.

1.03 OUTAGE PLANS

A. It is the Contractor's responsibility to coordinate and plan their construction activities in detail and provide such to the Owner as needed or as requested basis by the Owner or the Engineer. Outage plans shall be complete, concise, and provided a minimum of two weeks in advance to the Owner for review.

1.04 SCHEDULE CONSTRAINTS

A. It is the Contractor's responsibility to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall Work.

B. Unless approved by the Owner, work may only be done in one facility at a time.

C. Temporary heat will be required 24 hours a day, 7 days a week in buildings where existing heating facilities are inoperable during construction once low temperatures as expected to be below 40 degrees Fahrenheit.

1.05 CONSTRUCTION SEQUENCING

A. Return Activated Sludge (RAS)/Waste Activated Sludge (WAS) Pump Station No. 2:
   1. Construction work shall begin in RAS/WAS Pump Station No. 2.
   2. All valve and equipment changes to allow work to be done in RAS/WAS Pump Station No. 2 will be done by the Owner. RAS/WAS Pump Station No. 2 can be taken completely off-line.
   3. Provide a temporary generator to power the 37.5 KVA transformer and lighting panel.
   4. Demolish RW-MCC-C and RW-MCC-E2. Reserve the MCC and components to be used for temporary connections in other buildings.

5. Install the new RW-MCC-C RW-MCC-E2.
6. Submit Manufacturer's Certificate of Installation.
7. Perform field electrical acceptance testing.
8. Make all power and control connections, perform functional testing and put the new motor control centers into service.
9. Remove the temporary generator.

B. Chemical Building:
1. Provide a temporary generator to power the PCM (480 VAC), 10 kVA transformer, 75 KVA transformer and 37.5 KVA transformer. The work on CB-MCC shall not start until the temporary generator is installed and in operation.
2. Demolish CB-MCC.
3. Install the new CB-MCC.
4. Submit Manufacturer's Certificate of Installation.
5. Perform field electrical acceptance testing.
6. Make all power connections and put the new CB-MCC into service.
7. Remove the temporary generator.

C. Utility Water Pump Station:
1. Generator power to the Utility Water Pump Station is supplied from SG-EDA in the Generator Building.
    a. The conductors enter CC-MCC-A section 4 and are then routed to the emergency power bus in CC-MCC-B section 2.
    b. From the emergency power bus, conductors are connected to the emergency power breakers in each MCC.
2. Work in RAS/WAS Pump Station No. 2 shall be complete before work begins in the Utility Water Pump Station.
3. One of the Utility Water Pump Station motor control centers and 3 utility water pumps must be always in operation.
4. Before beginning work on CC-MCC-B, provide a temporary generator to power one of the 75 horsepower utility water pump VFDs powered from CC-MCC-B.
    a. Utilize MCC components from RAS/WAS Pump Station No. 2 as required.
5. Demolish the automatic transfer switch in CC-MCC-B.
    a. Isolating the automatic transfer switch using the circuit breakers in CCMCC-B will allow CC-MCC-A to continue to be fed from the existing generator power connection.
6. Install the new automatic transfer switch.
7. Make power connections.
8. Perform field electrical acceptance testing and functional testing.
9. Restore CC-MCC-B to service.
10. Restore the utility water pump on generator power to CC-MCC-B.
11. Provide a temporary generator to power the 10 KVA transformer and lighting panel.
12. Before beginning work on CC-MCC-A, provide a temporary generator to:
13. Power one of the 75 horsepower utility water pump VFDs powered from CCMCC-A.
14. Supply power to the automatic transfer switch in CC-MCC-B.
    a. Utilize MCC components from RAS/WAS Pump Station No. 2 as required.

15. Demolish CC-MCC-A:
    a. To allow for the demolition of CC-MCC-A, the existing emergency power connection from SG-EDA needs to be pulled back which removes emergency power from CC-MCC-B
16. Install the new CC-MCC-A.
17. Submit Manufacturer's Certificate of Installation.
18. Perform field electrical acceptance testing.
19. Make all power and control connections, perform and functional testing and put the new CB-MCC into service.
20. Restore the utility water pump on generator power to CC-MCC-A.
21. Remove the temporary generator.

D. Headworks:
1. HW-MCC-A powers influent pumps HW-P-4, HW-P-6 and HW-P-7, Boilers BL-0161, BL-0171 and HW,MCC-D. HW-MCC-B powers influent pumps HW-P-2, HW-P-3, and HW-P-5.
2. Provide a temporary generator to power Boilers BL-0161, BL-0171 and HW-MCC-D if the expected low temperatures are expected to be below 40 degrees Fahrenheit.
3. Three influent pumps shall be connected to utility power at all times.
    a. Provide a temporary generator to power one influent pump, when the MCC that feeds it is off-line. Coordinate the influent pump that will be connected to the generator with the Owner.
4. Coordinate with the Owner on the order of MCC Work.
5. Install the temporary generator and connect it to the selected influent pump VFD for demolition of HW-MCC-A.
6. Provide a temporary generator to power the 25 kVA transformer and panelboard LHW-2A.
7. Demolish HW-MCC-A.
8. Install the new HW-MCC-A.
9. Submit Manufacturer's Certificate of Installation.
10. Perform field electrical acceptance testing.
11. Make all power and control connections, perform functional testing, and put the new HW-MCC-A into service.
12. Place two influent pumps into operation before disconnecting the temporary generator and placing the third influent pump back into service on HW-MCC-A.
13. Provide a second temporary generator to power HW-MCC-C while HW-MCC-B is being replaced.
    a. Due to space constraints at the site, the temporary generator used to power HW-MCC-C cannot be the same generator used to power an influent pump.
    b. The work on HW-MCC-B shall not start until the temporary generators are installed and in operation.
14. Install the temporary generator and connect it to the selected influent pump VFD for demolition of HW-MCC-B.
15. Provide a temporary generator to power the 25 kVA transformer and panelboards LHW-2, LHW-2A.
16. Provide temporary supports for the conduit and wireway supported from HW-MCC-B.
17. Demolish HW-MCC-B.
18. Install the new HW-MCC-B and raceway supports.

19. Submit Manufacturer's Certificate of Installation.
20. Perform field electrical acceptance testing.
21. Make all power and control connections, perform functional testing, and put the new HW-MCC-B into service.
22. Place 2 influent pumps into operation before disconnecting the temporary generator and placing the third influent pump back into service on HW-MCC-B.
23. Remove all temporary generators.

E. RAS/WAS Pump Station No. 1:
1. All valve and equipment changes to allow work will to be done in RAS/WAS Pump Station No. 1 will be done by the Owner.
2. One of the following groups of equipment shall remain in service at all times:
    a. Clarifiers CLR-701, CLR-702. One Scum Pump PMPA-721 or PMPB-721. One WAS pump PMP-1601, PMP-1602 or PMP-1603. Two of three RAS pumps PMP-1401, PMP-1402, PMP-1403.

    Clarifiers CLR-703, CLR-704, One Scum Pump PMPA-722 or PMPB-722. One WAS pump PMP-1601, PMP-1602 or PMP-1603. Two of three RAS pumps PMP-1404, PMP-1405, PMP-1406.
3. Demolish the wiring between RW-MCC-E and Clarifiers FC-ME-3 (CLR-703) and FC-ME-4 (CLR-704).
4. Install the new RW-MCC-B.
5. Submit Manufacturer's Certificate of Installation.
6. Perform field electrical acceptance testing.
7. Make all power and control connections, perform functional testing, and put the new RW-MCC-B into service.
8. Install the new RW-MCC-EA.
9. Submit Manufacturer's Certificate of Installation.
10. Perform field electrical acceptance testing and functional testing.
11. Provide temporary wiring between RW-MCC-EA and clarifiers CLR-703, CLR-704 Scum Pump PMPA-722.
12. Provide a temporary generator to power the new RW-MCC-EA.
13. Provide a temporary generator to power RW-MCC-A-F. Only the WAS pumps need to be powered.
14. Provide a temporary generator to power the 50 KVA transformer and lighting panel.
15. Demolish RW-MCC-A and RW-MCC-E.
16. Install the new RW-MCC-A and RW-MCC-E.
17. Submit Manufacturer's Certificate of Installation.
18. Make all power and control connections, perform functional testing, and put the new RW-MCC-A and RW-MCC-E into service.
19. Remove the temporary wiring from RW-MCC-EA to clarifiers CLR-703, CLR-704 and Scum Pump PMPA-722.
20. Install the permanent wiring between RW-MCC-EA and clarifiers CLR-703, CLR-704 and Scum Pump PMPA-722 and RW-MCC-E to RW-MCC-EA.
21. Remove all temporary generators.

F. Solids Building.
1. Provide a temporary generator to power the 30 KVA transformer and lighting panel LP-SP-3, the 37.5 KVA transformer and lighting panel SPLP and one polymer mix feed unit.
    a. Utilize MCC components from RAS/WAS Pump Station No. 2 as required.

2. Demolish SP-MCC-B.
3. Install the new SP-MCC-B.
4. Perform field electrical acceptance testing.
5. Make all power and control connections and put the new SP-MCC-B into service.
6. Provide a temporary generator, starters and other electrical equipment to power the following:
    a. CV-1742 - Flat Belt Conveyor.
    b. CV-1741 - North Screw Conveyor.
    c. SP-B-1 - Air Compressor.
    d. 15 KVA transformer and lighting panel SP1A.
    e. EMV-1741 - Slide Gate.
    f. The Contractor may use previously demolished motor control centers, relocated to the Solids Building for this equipment.
7. Demolish SP-MCC-A and SP-MCC-E.
8. Install the new SP-MCC-A and SP-MCC-B.
9. Perform field electrical acceptance testing.
10. Make all power and control connections and put the new SP-MCC-A and SP-MCC-E into service.

G. Dispose of all demolished motor control centers.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

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

1.02 THE WORK

A. The Work consists of:
   1. Demolition of existing motor control centers, installation of new motor control centers and modifications to 2 existing motor control centers.
   2. Demolition of existing fiber optic cables and installation of new fiber optic cables.
   3. Demolition of existing fiber optic patch panels and installation of new fiber optic patch panels and connectors.
   4. Providing temporary power to support facility operations as specified in Section 01030 - Special Project Constraints.
   5. Commissioning of the Work.

1.03 LOCATION OF PROJECT

A. The Work is located at South Valley Water Reclamation Facility.

1.04 OWNER FURNISHED EQUIPMENT

A. Owner will furnish:
   1. The motor control centers specified in the Procurement Documents.

B. Owner will:
   1. Arrange for and deliver necessary Shop Drawings and product data to the Contractor.
   2. Arrange and pay for product delivery to site in accordance with the construction schedule.
   3. Deliver Supplier’s bill of materials to the Contractor.
   4. Inspect deliveries jointly with the Contractor.
   5. Submit claims for transportation damage.
   6. Arrange for replacement of damaged, defective, or missing items.
   7. Arrange for manufacturer's warranties, bonds, service, and inspections.

C. Contractor's responsibility for Owner-furnished products:
   1. Designating delivery date for each Owner-furnished product.
   2. Reviewing Shop Drawings and product data.
   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. Delegated design for anchoring and bracing.
9. Installing, including assembly, connections, adjustments, and commissioning in accordance with Contract Documents.
10. Providing incidental materials required for complete installation.
11. Repairing or replacing items damaged after receipt until date of Substantial Completion of the Work by Owner.

D. If the Owner fails to deliver products in accordance with accepted Construction Schedule, adjustments will be made to Contract Times and Contract Price as stipulated in General Conditions.

1.05 ACTIVITIES BY OTHERS

A. Activities by others which may affect performance of work include:
1. Programming the electronic overloads in the motor control centers and modifications to the SCADA system will be done by a systems integrator hired by the South Valley Water Reclamation Facility.
2. Configuration of the automatic transfer switches and automatic throw over controls will be supplied by Codale Electric Supply.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01116

CONTRACT DOCUMENT LANGUAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Explanation of arrangement, language, reference standards, and format.

1.02 REFERENCES

A. Construction Specifications Institute (CSI):
   1. MasterFormat™.
   2. SectionFormat™.
   3. PageFormat™.

1.03 PROJECT MANUAL ARRANGEMENT

A. Document and Section numbers used in Project Manual, and Project Manual arrangement are in accordance with CSI MasterFormat™, except where departures have been deemed necessary.

B. Sections are written in CSI SectionFormat™, Three-Part Section Format, except where departures have been deemed necessary.

C. Page format for Sections in the Project Manual is in PageFormat™, except where departures have been deemed necessary.

1.04 CONTRACT DOCUMENT LANGUAGE

A. Specification Section Paragraphs entitled "Section Includes" summarize briefly what is generally included in the section.
   1. Requirements of Contract Documents are not limited by "Section Includes" paragraphs.

B. Specifications have been partially streamlined by intentionally omitting words and phrases, such as "the Contractor shall," "in conformity therewith," "shall be" following "as indicated," "a," "an," "the" and "all."
   1. Assume missing portions by inference.

C. Phrase "by Engineer" modifies words such as "accepted," "directed," "selected," "inspected," and "permitted," when they are unmodified.

D. Phrase "to Engineer" modifies words such as "submit," "report," and "satisfactory," when they are unmodified.

E. Colons (:) are used to introduce a list of particulars, an appositive, an amplification, or an illustrative quotation:
   1. When used as an appositive after designation of product, colons are used in place of words "shall be."

F. Word "provide" means to manufacture, fabricate, deliver, furnish, install, complete, assemble, erect in place, test, or render ready for use or operation, including necessary related material, labor, appurtenances, services, and incidentals.

G. Words "Contractor shall" are implied when direction is stated in imperative mood.

H. Term "products" includes materials and equipment as specified in Section 01600 - Product Requirements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01140

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.

1.02 SUBMITTALS

A. Baseline Schedule with MOPO tasks.

B. Maintenance of Plant Operations (MOPO) Form.

C. Maintenance of Plant Operations (MOPO) Log.

D. Progress Schedule with MOPO tasks.

1.03 MAINTENANCE OF PLANT OPERATIONS (MOPO)

A. Comply with MOPO instructions as specified in Attachment A - Maintenance of Plant Operations (MOPO).

B. Prepare a MOPO for the following conditions:
   1. Shutdowns, diversions, and tie-ins to the existing facility.
   2. Process start-up activities.
   3. Power interruption and tie-ins.
   4. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
   5. Process constraints requiring interruption of operating processes or utilities.

C. Other Work not specifically listed may require MOPOs as determined necessary by the Contractor, Owner, or Engineer.

D. Submit Baseline Schedule as specified in Section 01321 - Schedules and Reports with proposed MOPOs.

E. Submit MOPO Log at construction progress meetings.

F. No consideration will be given to claims of additional time and cost associated to preparing MOPOs required by the Owner and Engineer to complete this work in a manner that facilitates proper operation of the facility and compliance with effluent discharge criteria.

G. Where required to minimize treatment process interruptions while complying with specified constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.04 GENERAL CONSTRAINTS ON WORK AND SCHEDULING OF WORK

A. Plant access for the Contractor will be provided at the main gate.

B. Wastewater projects:
   1. The South Valley Water Reclamation Facility is the Owner's only means of treating domestic and industrial wastewater prior to discharging the Jordan river . Impairing the operational capabilities of this treatment plant will result in serious environmental damage and monetary fines.
   2. Conduct Work, as specified in Section 01030 - Special Project Constraints, in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quantity of raw wastewater to the water quality limitations specified in the discharge permit.
   3. The status of the treatment plant shall be defined as "operational" when it is capable of treating the entire quantity of wastewater received to the water quality limits specified in the discharge permit.

1.05 COMPLIANCE WITH NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

A. The existing facility is operating under the terms of a National Pollutant Discharge Elimination System permit issued by the State of Utah.
   1. This permit specifies the water quality limits that the plant must meet prior to discharge of effluent.
   2. A copy of the existing permit is on file for review at the South Valley Water Reclamation Facility.

B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.

C. Bear the cost of penalties imposed on the Owner for discharge violations caused by actions of the Contractor.

D. Conduct the Work and provide temporary facilities required to keep the existing plant continuously operational.

E. Do not remove or demolish existing facilities required to keep the existing plant operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment.
   1. Test replacement facilities to demonstrate operational success prior to removing or demolishing existing facilities.

1.06 WORK BY OTHERS

A. Where proper execution of the Work depends upon work by others, inspect and promptly report discrepancies and defects.

1.07 SHUTDOWN CONSTRAINTS

A. General shutdown constraints:
   1. Execute the Work while the existing facility is in operation.
   2. Some activities may be accomplished without a shutdown.
   3. Apply to activities of construction regardless of process or work area.
   4. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
   5. Organize work to be completed in a minimum number of shutdowns.
   6. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
   7. Shutdown MOPOs:
      a. Advise the Engineer a minimum of 2 weeks prior to need for any complete or partial plant shutdown for tie-ins.
      b. Prepare and submit MOPO to the Engineer for any complete or partial plant shutdown required a minimum of 2 weeks prior to the shutdown.
      c. Owner's written approval of MOPO is required prior to beginning Work.
   8. Where required to minimize treatment process interruptions while complying with specified constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
   9. Final determination of the permitting of shutdowns will be the sole judgment of the Owner.
   10. Owner maintains the ability to abort on the day of the scheduled shutdown.
   11. Unplanned shutdowns due to emergencies are not specified in this Section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - MAINTENANCE OF PLANT OPERATIONS (MOPO)

"MAINTENANCE OF PLANT OPERATIONS" (MOPO)
Instructions and Forms

Definition and Purpose

"Maintenance of Plant Operations" (MOPO) is a detailed document submitted by the Contractor to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOPO provides a detailed plan to the Owner and Engineer that describes specific aspects of the work, including purpose, time of execution, and anticipated impacts on treatment processes. The MOPO also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The Owner should use the information within the MOPO to define operational procedures and methods to safely and successfully assist the Contractor.

MOPO Process Summary

WHO	STEP	TIMING
Contractor	1. Identify MOPOs needed on MOPO Log and Baseline Schedule	No later than 7 days prior to Preconstruction Scheduling Meeting
Contractor, Owner, Engineer	2. Pre-MOPO Meeting	More than 28 days prior to work
Contractor	3. Submits MOPO	No later than 28 days prior to work
Owner	4. Reviews MOPO	
Owner	5. MOPO finalized	No later than 7 days prior to work
Contractor	6. Complete Readiness Checklist	No later than 5 days prior to work
Contractor	7. Complete Safety Checklist	Immediately prior to commencing work
Contractor	8. Complete Work	
Contractor	9. Update MOPO Log and Progress Schedules	Monthly

MOPO Process Detail

STEP 1. Identifies MOPOs needed on MOPO Log and Baseline Schedule.

Contractor submits a preliminary list of anticipated project MOPOs on MOPO Log. MOPOs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPOs as tasks in Baseline Schedule. Date scheduled MOPOs to coincide with the appropriate construction activities.

STEP 2. Pre-MOPO Meeting.

Contractor requests a Pre-MOPO Meeting with the Owner and Engineer to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOPO Form. The pre-MOPO meeting may be waived by the Owner or Engineer if the work is deemed to be minor.

STEP 3. Submits MOPO.

Contractor completes the MOPO Form and submits 3 copies for approval to the Owner's Project Manager (OPM).

STEP 4. Reviews MOPO.

OPM distributes MOPO Form for review by the Owner's Construction Coordinator, O&M Representative, and Engineer's Project Representative. Review MOPO Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in Contract Documents, and to ensure that the requested work does not negatively impact plant operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOPO finalized.

Once the MOPO is agreed to by all parties, the MOPO will be finalized by signature. Copies are distributed to the Owner, Engineer, and Contractor.

STEP 6. Complete Readiness Checklist.

Contractor verifies everything is ready for the Work.

STEP 7. Complete Safety Checklist.

Contractor ensures safety.

STEP 8. Complete Work.

Contractor completes Work.

STEP 9. Update MOPO Log and Progress Schedules.

Contractor updates MOPO Log weekly and distributes at the regularly scheduled construction progress meetings.

ATTACHMENT B - MAINTENANCE OF PLANT OPERATIONS (MOPO) FORM

MAINTENANCE OF PLANT OPERATIONS (MOPO) FORM

Owner: _____ **Date:** _____

Contractor: _____ **Carollo Project No.:** _____

Project Name: _____ **Submittal No.:** _____

Submittal Title: _____ **Spec/Drawing. Ref.:** _____

MOPO #:	TASK TITLE: *(Provide <10 word title)*	SUBMITTAL DATE: *(No later than 28 days prior to work)*

SCHEDULE OF WORK ACTIVITY:

START: *(Date/Time)* END: *(Date/Time)*

REQUESTOR:

PRIMARY POINT OF CONTACT:	PHONE/PAGER:
SECONDARY POINT OF CONTACT:	PHONE/PAGER:

NOTIFY: ☐	Control Room, Phone:	☐	Security, Phone:

BUILDING:	LOCATION OF WORK FLOOR/LEVEL:

DESCRIPTION OF WORK: *(Provide sufficient details on process isolation, work sequencing, and safety (i.e. control of significant hazards unique to the work) to demonstrate an understanding of the work and how it will be completed within the constraints, and its impact on the processes and facility.)*

Task Summary: _____

Processes Affected: _____

Trades Affected: _____

WORK PLAN:

Work Sequencing: _____

Process Isolation: _____

Spill Prevention Plan: _____

Contingency Plans: _____

CRITICAL EQUIPMENT/TOOLS: *(Pumps and discharge hoses with correct fittings, blind flanges and pipe plugs, no-hub fittings, properly sized electrical service components, generators, portable lighting, chlorine for potable water pipe breaks, etc.)*

☐	Acoustic Ceiling/or Walls Access	☐	Excavation Permit	☐	Lock Out/Tag Out
☐	Chemical Use Approval	☐	Fire Sprinkler Impairment	☐	Life Safety Systems
☐	Confined Space Permit	☐	Flammable Materials	☐	Roof Protocol
☐	Critical Lift Plan	☐	Flush/Discharge	☐	Work After Dark
☐	Energized Electrical Work	☐	High Pressure Test	☐	
☐	Elect. Panel Schedules	☐	Hot Work/Open Flame	☐	

EXISTING SERVICE(S) AT RISK:							
☐	Breathing Air	☐	Elect Normal	☐	Process Access	☐	Telephones
☐	Chemical Distribution	☐	Fire Protection	☐	Safety Showers	☐	UPS
☐	City Water	☐	HVAC	☐	SCADA	☐	VAX/DATA
☐	Communication	☐	Inert Gas	☐	Security	☐	
☐	Domestic Drain	☐	Instrument - Air	☐	Solvent Drain	☐	
☐	Elect-Bus Duct	☐	Life Safety System	☐	Specialty Gases	☐	
☐	Elect. Emergency	☐	Natural Gas	☐	Storm Drain	☐	
REVIEWER'S INSTRUCTIONS/COMMENTS:							
☐	PREJOB BRIEFING MUST BE COMPLETED PRIOR TO COMMENCING WORK:						

	Full Name (printed)	**Signature**	**Phone**	**Date**
Submitted By				
System Owner				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				

ATTACHMENT C - READINESS CHECKLIST

READINESS CHECKLIST

(5 days prior to work)

Checklist provided as a guide but is not all inclusive.

1. Confirm all parts and materials are onsite: _____

2. Review work plan: _____

3. Review contingency plan: _____

ATTACHMENT D - SAFETY CHECKLIST

SAFETY CHECKLIST

(Just prior to commencing work)

Checklist provided as a guide but is not all inclusive.

1. Location awareness:
   a. Emergency exits: _____
   b. Emergency shower and eyewash: _____
   c. Telephones and phone numbers: _____
   d. Shut-off valve: _____
   e. Electrical disconnects: _____
2. Inspect work area:
   a. Take time to survey the area you are working in. Ensure that what you want to do will work. Do you have enough clearance? Is your footing secure? Do you have adequate lighting and ventilation? Are surrounding utilities out of the way for you to perform your work?
3. SDS (Safety Data Sheets):
   a. Understand the chemicals and substances in the area you are working in by reading the SDS.
4. Lockout/tagout procedure:
   a. Lockout/tagout energy sources before beginning work.
   b. Make sure all valves associated with the work are locked out and tagged out on each side of the penetration.
   c. Make sure the lines are depressurized.
5. Overhead work:
   a. Use appropriate personal protective equipment; i.e., safety harness, lifeline, etc.
   b. Select appropriate tie-off points; i.e., structurally adequate, not a pipe or conduit, etc.
   c. Spotter assigned and in position.
   d. Pipe rack access; i.e., check design capacity, protective decking or scaffolding in place, exposed valves or electrical switches identified and protected.
6. Safety equipment:
   a. Shepherd's hook.
   b. ARC flash protection.
   c. Fire extinguisher.
   d. Other: _____
7. Accidents:
   a. Should accidents occur, do not shut off and do not attempt to correct the situation unless you are absolutely positive that your action will correct the problem and not adversely affect other people or equipment.
8. Review process start-up documents:
   a. In the event the system is shutdown, the Control Center should have a working knowledge of the process start-up procedures in order to deal effectively with unforeseen events.
9. Evacuation procedures:
   a. Do not obstruct evacuation routes.
   b. Take time to survey the area for evacuation routes.

ATTACHMENT E - MAINTENANCE OF PLANT OPERATIONS (MOPO) LOG

MAINTENANCE OF PLANT OPERATIONS (MOPO) LOG
Sample

MOPO Number	Task Title	Date Requested	Date Approved	Date Work Planned	Work Completed (Yes/No)
001					
002					
003					

SECTION 01260

CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for executing a change in the Work.

1.02 PRELIMINARY REQUIREMENTS

A. Change Order Cost Basis Summary Form:
   1. Submit a sample to Engineer for review within 15 calendar days following Notice to Proceed.
      a. Items will be reviewed and their value, percentage, or calculation method mutually agreed to by the Contractor and Owner prior to executing a Change Order on the Project.
   2. Used by the Contractor for pricing each Change Order required for additions, deletions, or revisions in the Work.
   3. Include the following information:
      a. Agreed upon markups, percentages, and procedures for calculating all surcharges, etc. associated with the Cost of the Change Order Work.
      b. References for unit price information and special unit price information.
      c. Attachments with the following information:
         1) Certified labor rates breakdown.
         2) Equipment rates.
         3) Bond and insurance rates (PI&I).

1.03 REQUEST FOR INFORMATION OR INTERPRETATION (RFI)

A. Contractor may issue RFIs to request interpretation of the documents or to request for information that may be missing.

B. General Instructions:
   1. Number RFIs consecutively.
      a. Add a consecutive letter to the RFI number on modified submittals of the same RFI (i.e., RFI 4B).
   2. Provide RFI for 1 item.
      a. There may be exceptions when multiple items are so functionally related that expediency indicates review of the group of items as a whole.
      b. RFIs with multiple items will be rejected without review.
   3. Contractor sign and date RFIs indicating review and approval.
      a. Contractor’s signature indicates that they have satisfied RFI review responsibilities and constitutes Contractor's written approval of RFI.

b. RFIs without Contractor's signature will be returned to the Contractor unreviewed. Subsequent submittal of this information will be counted as the first resubmittal.

C. Engineer will render a written clarification, interpretation, or decision on the issue submitted or initiate an amendment or supplement to the Contract within 21 days.
   1. In the event the Contractor identifies an RFI as critical to the progress of the project, Engineer will make every effort to reduce the RFI response time.

1.04 PRELIMINARY PROCEDURES

A. Owner or Engineer may initiate changes by submitting a Request for Proposal (RFP) to Contractor including the following information:
   1. Detailed description of the Change, Products, and location of the change in the Project.
   2. Supplementary or revised drawings or specifications.
   3. Projected time span for making the change, and a specific statement if overtime work is authorized.
   4. A specific period of time during which the requested price will be considered valid.
   5. Such request is for information only, and is not an instruction to execute the changes, or to stop work in progress.

B. Contractor may initiate changes by submitting a Change Proposal to Engineer containing the following:
   1. Description of proposed changes.
   2. Reason for making changes.
   3. Specific period of time during which requested price will be considered valid.
   4. Effect on Total Contract Cost and/or Contract Time.
   5. Documentation supporting any change in Total Contract Cost and/or Contract Time, as appropriate.

1.05 WORK CHANGE DIRECTIVE AUTHORIZATION

A. In lieu of a Request for Proposal (RFP), Engineer may issue a Work Change Directive Authorization for Contractor to proceed with a change for subsequent inclusion in a Change Order.

B. Authorization will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change and will designate method of determining any change in the Contract Sum and/or the Contract Time, as appropriate.

C. Owner and Engineer will sign and date the Work Change Directive Authorization as authorization for the Contractor to proceed with the changes.

D. Contractor may sign and date the Work Change Directive Authorization to indicate agreement with the terms.

1.06 DOCUMENTATION OF CHANGE PROPOSALS

A. Change proposal:
   1. Support with sufficient substantiating data to allow Engineer to evaluate the quotation.
      a. Lump sum.
      b. Unit prices: Use previously established unit prices.
      c. Time-and-material/force account basis:
         1) Name of the Owner's authorized agent who ordered the work, and date of the order.
         2) Dates and times work was performed, and by whom.
         3) Time record, summary of hours worked, and hourly rates paid.
         4) Receipts and invoices for:
            a) Equipment used, listing dates and times of use.
            b) Products used, listing of quantities.
            c) Subcontracts.
   2. Provide additional data to support time and cost computations:
      a. Labor required.
      b. Equipment required.
      c. Products required:
         1) Recommended source of purchase and unit cost.
         2) Quantities required.
      d. Taxes, insurance, and bonds.
      e. Credit for work deleted from Contract, similarly documented.
      f. Overhead and profit.
      g. Justification for change to Contract Time.

1.07 PREPARATION OF CHANGE ORDERS AND FIELD ORDERS

A. Engineer will prepare each Change Order and Field Order.

B. Change Orders:
   1. Will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change.
   2. Will provide an accounting of the adjustment in the Contract Sum and in the Contract Time.
   3. Recommendation of Change Proposal is indicated by Engineer's signature.
   4. Upon signature and execution by Owner, the Change Proposal becomes a Change Order altering the Contract Time and Total Contract Cost, as indicated.
      a. Owner's Representative will transmit one signed copy each to Contractor and Engineer.
   5. Contractor may only request payment for changes in the Work against an approved Change Order.
   6. If either Engineer or Owner's Representative disapproves the Change Proposal, the reason for disapproval will be stated.
      a. A request for a revised proposal or cancellation of the proposal will be shown.

C. Field Orders:
   1. Order minor changes in the Work without changes in Contract Price or Contract Times.

1.08 LUMP-SUM/FIXED PRICE CHANGE ORDER

A. Content of Change Orders will be based on, either:
   1. Engineer's Proposal Request and Contractor's responsive Change Proposal as mutually agreed between Owner and Contractor.
   2. Contractor's Change Proposal for a change, as recommended by Engineer.

B. Owner and Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time and serve as authorization for the Contractor to proceed with the changes.

C. Contractor will sign and date the Change Order to indicate agreement with the terms.

1.09 UNIT PRICE CHANGE ORDER

A. Content of Change Orders will be based on, either:
   1. Engineer's definition of the scope of the required changes.
   2. Contractor's Change Proposal for a change, recommended by Engineer.
   3. Survey of completed work.

B. The amounts of the unit prices to be:
   1. Those stated in the Contract.
   2. Those mutually agreed upon between Owner and Contractor.

C. When quantities of each of the items affected by the Change Order can be determined prior to start of the work:
   1. Owner and Engineer will sign and date the Change Order as authorization for Contractor to proceed with the changes.
   2. Contractor will sign and date the Change Order to indicate agreement with the terms.

D. When quantities of the items cannot be determined prior to start of the work:
   1. Engineer or Owner will issue a Work Change Directive authorization directing Contractor to proceed with the change on the basis of unit prices, and will cite the applicable unit prices.
   2. At completion of the change, Engineer will determine the cost of such work based on the unit prices and quantities used.
   3. Contractor shall submit documentation to establish the number of units of each item and any claims for a change in Contract Time.

E. Owner and Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time and serve as authorization for the Contractor to proceed with the changes.

F. Contractor will sign and date the Change Order to indicate their agreement with the terms.

1.10 TIME AND MATERIAL/FORCE ACCOUNT CHANGE ORDER/WORK CHANGE DIRECTIVE AUTHORIZATION

A. Engineer will issue a Work Change Directive for the Owner's signature authorizing Contractor to proceed with the changes.

B. At completion of the change, Contractor shall submit itemized accounting and supporting data as specified in this Section.

C. Engineer will determine the allowable cost of such work, as provided in the Contract Documents.

D. Owner and Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time and serve as authorization for the Contractor to proceed with the changes.

E. Contractor will sign and date the Change Order to indicate their agreement.

1.11 CORRELATION WITH CONTRACTOR'S SUBMITTALS

A. Periodically revise Schedule of Values and Applications for Payment forms to record each Change Order as a separate item of Work, and to record the adjusted Contract Sum.

B. Periodically revise the Construction Schedule to reflect each change in Contract Time. Revise subschedules to show changes for other items of work affected by the changes.

C. Upon completion of work under a Change Order, enter pertinent changes in Record Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01312

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
      a. Qualifications of Meeting Participants.
      b. Basic Meeting Requirements.
      c. Pre-construction Conference.
      d. Pre-construction Safety Conference.
      e. Web Based Construction Document Management Software Training.
      f. Progress Meetings.
      g. Schedule Update Meetings.
      h. Quality Control Meetings.
      i. Pre-Installation Meetings.
      j. Maintenance of Plant Operations (MOPO) Meetings.
      k. Commissioning Coordination Meetings.
      l. Close-out Meeting.
      m. Post Construction Meeting.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1.03 BASIC MEETING REQUIREMENTS

A. Attendees:
   1. Meeting leader shall require attendance of parties directly affecting, or affected by, Work being discussed at the meeting.

B. Location:
   1. At the Owner's facility.

C. Notification:
   1. Meeting leader shall notify attendees of meeting, including an agenda, a minimum of 7 days prior to meeting.

D. Agenda:
   1. Meeting leader shall prepare copies of the agenda for participants and distribute at the meeting.
   2. Minimum requirements:
      a. Meeting purpose.

b. Review minutes of previous meeting.
c. Safety and security.
d. Discuss issues.
e. Action items.
f. Next meeting.

E. Meeting minutes:
1. Meeting leader shall prepare draft minutes and send to attendees for comment within 7 days.
2. Meeting leader shall incorporate comments from attendees and submit final meeting minutes to attendees within 7 days of receipt of comments.

1.04 PRE-CONSTRUCTION CONFERENCE

A. Engineer leads the meeting.

B. Timing:
1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable.

C. Required attendees:
1. Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to the agenda.

D. Agenda minimum requirements:
1. Meeting purpose:
a. To establish working understanding between parties and to discuss Construction Schedule, Shop Drawings and other Submittals, cost breakdown of major lump sum items, processing of Submittals and applications for payment, and other subjects pertinent to execution of the Work.
2. Adequacy of distribution of Contract Documents.
3. Distribution and discussion of list of major subcontractors and suppliers.
4. Proposed progress schedules and critical construction sequencing.
5. Major equipment deliveries and priorities.
6. Project coordination.
7. Designation of responsible personnel.
8. Procedures and processing of:
a. Field decisions.
b. Proposal requests.
c. Submittals - separate meeting.
d. Change Orders.
e. Request for Information/Interpretations.
f. Applications for Payment.
g. Record documents.
9. Use of premises:
a. Office, construction, and storage areas.
b. Owner's requirements.
10. Construction facilities, controls, and construction aids.
11. Temporary utilities.
12. Safety and first aid procedures.

13. Security procedures.
14. Housekeeping procedures.
15. Safety and security.
16. Review proposed photographer Submittal.
17. Action items.
18. Next meeting.

1.05 PRE-CONSTRUCTION SCHEDULING MEETING

A. Engineer leads the meeting.

B. Timing:
   1. Within 7 days of Notice to Proceed, or earlier when mutually agreeable.

C. Required attendees:
   1. Contractor's project manager, superintendent, scheduler, Owner, Engineer, and others necessary to the agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. To establish the format and features of the Construction Schedule.
   2. Schedule preparation.
   3. Reporting requirements.
   4. Updates and revision procedures.
   5. Schedule delay analysis procedures.
   6. Schedule methodology.
   7. Planned sequence of operations.
   8. Cost and labor loading methodology.
   9. Proposed activity coding structure as specified in Section 01321 - Schedules and Reports.
   10. Naming convention: Name schedule files with the year, month and day of the data date, revision identifier, and a description of the schedule.
      a. Example 1: 2021_07_30 rev 1 draft baseline schedule.xer.
      b. Example 2: 2021_09_30 rev 2 sep final update.xer.
   11. Action items.
   12. Next meeting.

1.06 PRE-CONSTRUCTION SAFETY CONFERENCE

A. Owner leads the meeting.

B. Timing:
   1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable.

C. Required attendees:
   1. Contractor's project manager, safety representative, and superintendent; Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to the agenda.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. To establish safety procedures and identify lead participants.
    2. Review minutes of previous meeting.
    3. Safety and first aid procedures.
    4. Review of Experience Modification Rating for Contractor and each Subcontractor.
    5. Security procedures.
    6. Housekeeping procedures.
    7. Safety and security.
    8. Action items.
    9. Next meeting.

1.07 WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT SOFTWARE TRAINING

A. Contractor can submit a written request to the Engineer to waive the training based on staff having sufficient familiarity with the software and its complete usage. Engineer will lead the meeting.

B. Timing:
    1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable,
    2. Duration minimum: 2 hours.

C. Required attendees:
    1. Mandatory attendance.
        a. Contractor’s project manager.
        b. Contractor’s field superintendent.
        c. Contractor’s project engineer.
    2. Other attendees:
        a. Owner, Engineer, Contractor’s quality control manager, Contractor’s project scheduler and any other persons involved with preparing and transmitting documents.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. Train construction team on the use of the web based document management system software.
    2. Safety.
    3. General Items.
    4. Contractor functions.
    5. Owner functions.
    6. Engineer functions.
    7. Action items.

1.08 PROGRESS MEETINGS

A. Engineer will lead the meeting.

B. Timing:
    1. Hold meetings throughout progress of the Work at maximum weekly intervals.

C. Required attendees:
   1. Owner, Engineer, Contractor, Contractor's project manager, superintendent, quality control manager, project scheduler, major subcontractors and suppliers as appropriate to the agenda topics for each meeting.
   2. Additional invitees:
      a. Owner utility companies when the Work affects their interests, and others necessary to the agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Provide the status of the Work.
   2. Review minutes of previous meeting.
   3. Safety and security.
   4. Construction schedule summary.
   5. Review of 6 weeks schedule.
      a. Contractor shall provide printed hard copies for each attendee.
   6. Review of off-site fabrication and delivery schedules.
   7. Review of Submittals schedule and status of Submittals.
   8. Request for information (RFI's) status.
   9. MOP's/shutdown coordination.
   10. Change order management status.
   11. Maintenance of quality standards (QA/QC).
   12. Field observations, problems, and conflicts.
   13. Commissioning.
   14. Partnering recognition status (optional).
   15. General items.
   16. Action items.
   17. Next meeting.

1.09 SCHEDULE UPDATE MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. Hold meetings throughout progress of the Work at maximum monthly intervals.

C. Required attendees:
   1. Owner, Engineer, Contractor, Contractor's project manager, general superintendent, project scheduler, major subcontractors and suppliers as appropriate to the agenda topics for each meeting.
   2. Additional invitees:
      a. Owner utility companies when the Work affects their interests and others necessary to the agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Identify and troubleshoot scheduling issues in a collaborative environment.
      b. Provide further detail on Work status.
   2. Review minutes of previous meeting.

3. Review Monthly Schedule, (Actual Progress and Variance).
    a. “Activities Started/Completed” this period.
    b. “Activities Started/Completed” “Variance” Baseline vs. current.
    c. “Added/Deleted Activities”.
    d. “Revised Activity Descriptions”.
    e. Any significant Proposed Logic Changes.
4. Review milestone “Substantial Completion” Schedule:
    a. “Critical” Activities - “Critical Area, Float and Vital Statistics”.
5. Review “Cumulative and Monthly Costs” graph.
6. Review “Budgeted Cost” indicating the Current Project Budgeted Cost.
7. Safety and security.
8. Action items.
9. Next meeting.

1.10 PRE-INSTALLATION MEETINGS

A. Contractor leads the meeting.

B. Timing:
    1. When specified in Technical Sections or requested by Engineer, before commencing Work of specific section.

C. Required attendees:
    1. Owner, Engineer, Contractor, Contractor’s project manager, general superintendent, project scheduler, major subcontractors including electrical instrumentation, and suppliers as appropriate to the agenda topics for each meeting.
    2. Additional invitees:
        a. Owner utility companies when the Work affects their interests and others necessary to the agenda.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. Review conditions of installation, preparation, and installation procedures.
        b. Review coordination with related work.
    2. Review minutes of previous meeting.
    3. Safety and security.
    4. Action items.
    5. Next meeting.

1.11 PRE-SHUTDOWN MEETINGS

A. Contractor leads the meeting.

B. Timing:
    1. Short-term and longer-term shutdowns and other tie-ins that require an Owner approved MOP require a pre-shutdown meeting at Project site at least 3 working days prior to commencing shutdown for tie-in or modification of specific plant systems.

C. Required attendees:
   1. Require attendance of parties directly affecting, or affected by shutdown, including Engineer, specific work crews, Owner's construction, operations, and maintenance staff.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Review conditions of installation, preparation, and installation procedures.
      b. Review coordination with related work.
   2. Review minutes of previous meeting.
   3. Review accepted Construction Method of Procedure (MOP), as specified in Attachment A of Section 01140 - Work Restrictions, including conditions of shutdown, preparation, and installation procedures.
   4. Review timelines and sequences.
   5. Review responsibilities.
   6. Review dry run plan and schedule, as necessary.
   7. Review coordination with related work.
   8. Safety and security.
   9. Action items.
   10. Next meeting.

1.12 QUALITY CONTROL MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. Hold meetings throughout progress of the Work at maximum weekly intervals.

C. Required attendees:
   1. Engineer, Construction manager and staff, Contractor's quality control manager, and staff.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Update Contractor's efforts to comply with quality requirements in the Contract Documents.
   2. Review minutes of previous meeting.
   3. Review of Work progress and schedule.
   4. Review of out-of-compliance inspection or test results.
   5. Field observations, problems, and decisions.
   6. Review of offsite fabrication and delivery schedules.
   7. Planned progress during succeeding work period.
   8. Coordination of required inspections and tests.
   9. Review 6-week schedule report with upcoming inspections and special tests.
   10. Maintenance of quality and work standards.
   11. Other business relating to Work.
   12. Safety and security.
   13. Action items.
   14. Next meeting.

1.13 COMMISSIONING COORDINATION MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. Separate commissioning coordination meetings will be scheduled as required by the Engineer.

C. Required attendees:
   1. Require attendance of parties directly affecting, or affected by process start-up and testing, including Engineer, Commissioning Coordinator, specific work crews, Owner's operations, and maintenance staff.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Coordinate commissioning activities.
   2. Review minutes of previous meeting.
   3. Review Commissioning schedule.
   4. Review Owner Training schedule.
   5. Review test plans.
   6. Review accepted Construction Method of Procedure (MOP), as specified in Attachment A of Section 01140 - Work Restrictions.
   7. Owner makes final decision for commissioning GO or NO GO.
   8. Safety and security.
   9. Action items.
   10. Next meeting.

1.14 CLOSE-OUT MEETING

A. Owner leads the meeting.

B. Timing:
   1. After punch list items are completed.

C. Required attendees:
   1. Owner, Engineer, Contractor, Contractor's project manager, and superintendent.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Coordinate close-out activities.
   2. Review minutes of previous meeting.
   3. Review punch list completion.
   4. Transfer of record documents.
   5. Finalize payment.
   6. Safety and security.
   7. Action items.
   8. Next meeting.

1.15 POST CONSTRUCTION MEETING

A. Owner leads the meeting.

B. Timing:
   1. About 11 months after date of Substantial Completion.

C. Location:
   1. Meet in Owner's office or other mutually agreed upon place.

D. Required attendees:
   1. Engineer, Contractor, appropriate manufacturers, and installers of major units of constructions, affected Subcontractors, and Owner's operations and maintenance staff.

E. Agenda minimum requirements:
   1. Meeting purpose:
      a. Review Project for compliance with the Contract Documents.
   2. Inspect the Work and draft list of items to be completed or corrected.
   3. Review service and maintenance contracts and take appropriate corrective action when necessary.
   4. Complete or correct defective work and may extend correction period.
   5. Safety and security.
   6. Action items.
   7. Next meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01321

SCHEDULES AND REPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Schedules and reports.

1.02 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. Baseline schedule: A planned and approved timetable projection that illustrates the project execution strategy, key deliverables, planned activity dates and milestones.
   2. Critical path: The longest sequence of dependent tasks in a project.
   3. Near critical path: The longest path after the critical path.
   4. Weather day: The Contractor being prevented or inhibited from performing at least 4 hours of work on the critical path due to weather conditions.

1.03 SCHEDULING FORMAT

A. Utilize critical path method (CPM) format.

B. Provide a cost and labor loaded Schedule.

C. Engineer approval of the format is required.

1.04 SCHEDULING HARDWARE AND SOFTWARE

A. Scheduling software and hardware shall be located on-site.

B. Prepare computerized schedule utilizing the most current version of Oracle Primavera P6 or Asta Powerproject.

C. Contractor and Engineer must agree on the format.

1.05 SCHEDULE PREPARATION

A. Preparation and submittal of Progress Schedule represents Contractor’s intention to execute the Work within specified time and constraints.

B. All costs associated with Schedule requirements are included in the Contract Price.

C. During preparation of the preliminary Progress Schedule, the Engineer will facilitate Contractor’s efforts by answering questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.

D. Prepare Schedule utilizing precedence diagramming method (PDM).

E. Prepare Schedule utilizing activity durations in terms of working days.
   1. Do not exceed a 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries.
   2. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work.
   3. Coordinate holidays to be observed with the Owner and incorporate them into the Schedule as non-working days.

F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Contract.
   1. Contract requirements are not waived by failure of Contractor to include required Schedule constraints, sequences, or milestones in Schedule.
   2. Contract requirements are not waived by Owner's acceptance of the Schedule. In the event of conflict between accepted Schedule and Contract requirements, terms of Contract govern at all times, unless requirements are waived in writing by the Owner.

G. Reference Schedule to working days beginning with Notice to Proceed as Contract Time as Day "1".

H. Baseline Schedule and project completion:
   1. Should Contractor submit a Baseline Schedule showing project completion more than 20 working days prior to Contract completion date, Owner may issue Change Order, at no cost to Owner, revising time of performance of Work and Contract completion date to match Contractor's Schedule completion date.
   2. Adjust accordingly any Contract milestone dates.

I. Imposed dates and hidden logic are prohibited.

J. Interim milestone dates, operational constraints:
   1. In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on Schedule.
   2. Do not use zero total float constraint or mandatory finish date on such Contract requirements.

K. Contract float is for the mutual benefit of both Owner and Contractor.
   1. Changes to the Project that can be accomplished within this available period of float may be made by Owner without extending the Contract Time by utilizing float.
   2. Time extensions will not be granted nor delay damages owed until Work extends beyond currently accepted Contract completion date.
   3. Likewise, Contractor may utilize float to offset delays other than delays caused by the Owner.
   4. Mutual use of float can continue until all available float shown by Schedule has been utilized by either Owner or Contractor, or both. At that time, extensions of the Contract Time will be granted by Owner for valid Owner-caused or third party-caused delays which affect the planned completion date and which have been properly documented and demonstrated by Contractor.

5. Non-sequestering of float: Pursuant to float sharing requirements of Contract, Schedule submittals can be rejected for use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations, or imposed dates.

L. Resource loading and leveling:
   1. Input labor data on each schedule activity.
   2. Manpower data consists of the man-hours estimated to perform each task, categorized by trade.
   3. Provide leveled manpower requirements.
      a. Availability of the resources drive activity duration.

M. Schedule windows for Owner-furnished, Contractor-installed equipment or materials:
   1. Immediately after Award of Contract, obtain from Engineer anticipated delivery dates of Owner furnished equipment or materials.
   2. Show these dates in the Schedule in same manner indicated by the Engineer.

1.06 SCHEDULER

A. Designate, in writing within 5 calendar days after Notice of Award, the person responsible for preparation, maintenance, updating, and revision of all schedules.

B. Scheduler shall have the authority to update Schedule on behalf of the Contractor.

C. Scheduler:
   1. Scheduler will attend all project meetings called for as specified in Section 01312 - Project Meetings.

1.07 SUBMITTAL REQUIREMENTS

A. Preliminary and Baseline Progress Schedule.

B. Preliminary and Baseline Schedule of Values.

C. Preliminary and Baseline Schedule of Submittals.

D. On a monthly basis, updated Schedules as specified.

E. Final Schedules update as specified.

F. Revised Schedules and time impact analyses as specified.

G. Submit Schedules in the media and number of copies as follows:
   1. PDF format and in other formats specified in this Section.
   2. Two sets of CPM Schedule data electronic files in a native backed-up file format.

1.08 GANTT CHART

A. Produce a clear, legible, and accurate calendar based, time scaled, and graphical network diagram.
   1. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.

B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.

C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished.
   1. Incorporate the basic concept of the precedence diagram network method to show how the start of 1 activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.

D. Provide Progress Schedule showing the critical path for the Project.

E. Provide report of Near Critical Path activities for the Project, when required by the Engineer.

F. Delineate the specified Contract Times and identify the planned completion of the Work as a milestone.
   1. Show the time period between the planned and Contract completion dates, if any, as an activity identified as Project float.

G. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion dates as milestones.

H. Include, in addition to construction activities:
   1. Any activity by the Owner or the Engineer that may affect progress or required completion dates.
   2. Equipment and long-lead material deliveries over 8 weeks.
   3. Approvals required by regulatory agencies or other third parties.

I. Produce electronic network diagram on 22-inch by 34-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.

J. Identify the execution of the following:
   1. Mobilization.
   2. All required Submittals and Submittal review times showing 30 calendar day duration for such activities and equal amount of time for resubmittal reviews.
   3. Equipment and materials procurement/fabrication/delivery.
   4. Demobilization.

1.09 PRELIMINARY SCHEDULE

A. Procedure:
   1. Submit proposed Preliminary Schedule within 14 calendar days after Notice to Proceed.

2. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule to review and make necessary adjustments.
3. Submit revised Preliminary Schedule within 5 calendar days after meeting.
4. Update Preliminary Schedule monthly until the Baseline Schedule is accepted.

B. Format:
1. Simplified Gannt chart.

C. Activities:
1. Define activities to be completed in the first 90 calendar days of Work.
2. Actualize activities performed during the first 90 days into the first monthly Schedule update.

1.10 PRELIMINARY SCHEDULE OF VALUES

A. Procedure:
1. Submit proposed Preliminary Schedule of Values within 14 calendar days after Notice to Proceed.
2. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule of Values to review and make necessary adjustments.
3. Submit revised Preliminary Schedule of Values within 5 calendar days after meeting.

1.11 WORK WITHIN THE FIRST 90 DAYS

A. Proceed with Work after Preliminary Schedule and Preliminary Schedule of Values have been accepted by Owner.

B. Submittal and acceptance of Preliminary Schedule and Preliminary Schedule of Values is condition precedent to making of progress payments as specified in Section 00622 - Contractor's Application for Payment and payments for mobilization costs otherwise provided for in the Contract.

1.12 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals shall include Submittals required in the Contract Documents but not limited to test plans, training plans, test procedures, operation and maintenance manuals, Shop Drawings, samples, record documents, and specifically required certificates, warranties, and service agreements.

B. Schedule of Submittals:
1. Due date: 30 days after Baseline Schedule has been submitted and accepted by Owner.
2. Format:
a. Include Submittals using early start dates.
b. Include all Submittals, including those required in the Preliminary Schedule of Submittals.
c. Indicate week and month anticipated for submittal to Engineer.

d. Indicate “Priority” submittals where review time can impact Contractor’s schedule.
    1) “Priority” indication will not alter review times specified in Section 01330 - Submittal Procedures.
    2) Engineer will endeavor to provide early review of “Priority” Submittals where possible.

3. Submittal of Schedule of Submittals shall be a condition precedent to Owner making progress payments after the first 90 calendar days after Notice to Proceed.

C. Provide updated Schedule of Submittals with updated schedules if Schedule revisions change listing and timing of Submittals.

1.13 BASELINE PROGRESS SCHEDULE AND BASELINE SCHEDULE OF VALUES

A. Due date: No more than 45 calendar days after Notice to Proceed.

B. Format:
1. Progress Schedule: Show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract.

1.14 SUMMARY SCHEDULE

A. Due date: At weekly progress meetings and after each Schedule update or Schedule revision.

B. Format:
1. Consolidate groups of activities associated with Major Items of Work shown on Baseline Schedule.
2. Intended to give an overall indication of the Project Schedule without a large amount of detail.

1.15 COST FLOW SUMMARY

A. Due date: After Baseline Schedule has been submitted and accepted by the Owner, submit on a monthly basis as specified in Section 00622 - Contractor's Application for Payment.

B. Format:
1. Tabular and graphic report showing anticipated earnings each month of the Contract period.
2. Base tabulation on the summation of the cost-loaded activities each month.
3. Show planned amounts.
4. Show actual earned amounts and anticipated remaining earnings.
5. Spreadsheet format of all schedule activities showing cost and percentage completion during the current month for which payment is sought.

1.16 PROGRESS SCHEDULE AND UPDATED SCHEDULE OF VALUES

A. Due date: Submit on a monthly basis as specified in Section 00622 - Contractor's Application for Payment.

1.17 WEEKLY SCHEDULE

A. Due date: At every weekly progress meeting.

B. Format:
   1. Contractor and Engineer must agree on the format.
   2. Six-week schedule showing the activities completed during the previous week and the Contractor’s schedule of activities for following 5 weeks.
   3. Use the logic and conform to the status of the current Progress Schedule when producing a weekly Schedule in CPM schedule or a bar chart format.
      a. In the event that the weekly Schedule no longer conforms to the current Schedule, Contractor may be required to revise the Schedule as specified in this Section.
   4. Activity designations used in the weekly Schedule must be consistent with those used in the Baseline Schedule and the monthly Schedule updates.

1.18 LABOR HISTOGRAM

A. Due date:
   1. With progress payments after Baseline Schedule has been submitted and accepted by Owner.

B. Format:
   1. Labor histogram depicting total craft manpower and craft manpower for Contractor’s own labor forces and those of each subcontractor.
   2. Submit in electronic format.

1.19 PRE-CONSTRUCTION SCHEDULING MEETING

A. As specified in Section 01312 - Project Meetings.

1.20 REVIEW AND ACCEPTANCE OF SCHEDULES

A. Engineer will review preliminary Schedules, Schedule updates, Schedule revisions, and time impact analyses to ascertain compliance with specified project constraints, compliance with milestone dates, durations and sequence, accurate inter-relationships, and completeness.

B. Engineer and Owner will issue written comments following completion of review of baseline Schedules within 21 calendar days after receipt.

C. Written comments on review of Schedule updates and Schedule revisions and time impact analyses will be returned to Contractor within 14 calendar days after receipt by Engineer.

D. Revise and resubmit Schedules in accordance with Engineer's comments within 7 calendar days after receipt of such comments or request joint meeting to resolve objections.

E. If the Engineer requests a meeting, the Contractor and all major subcontractors shall participate.
   1. Revise and resubmit Schedule within 7 calendar days after meeting.

F. Use accepted Schedules for planning, organizing, and directing the Work and for reporting progress.

G. Engineer's Submittal review response:
   1. When Schedules reflects the Owner's and Contractor's agreement of project approach and sequence, Schedules will be accepted by the Owner.
   2. Engineer's Submittal review response for Schedule Submittals will be "Receipt Acknowledged - Filed for Record".
   3. Acceptance of the Schedules by the Owner is for general conformance with the Contract Documents and for the Owner's planning information and does not relieve the Contractor of sole responsibility for planning, coordinating, and executing the Work within the Contract completion dates.
      a. Omissions and errors in the accepted Schedules shall not excuse performance less than that required by the Contract Documents.
      b. Acceptance by the Owner in no way constitutes an evaluation or validation of the Contractor's plan, sequence or means, methods, and techniques of construction.

1.21 SCHEDULE UPDATES

A. Any update:
   1. Prepare update using most recent accepted version of Schedule including:
      a. Actual start dates of activities that have been started.
      b. Actual finish dates of activities that have been completed.
      c. Percentage of completion of activities that have been started but not finished.
      d. Actual dates on which milestones were achieved.
      e. Update activities by inputting percent complete figures with actual dates.
      f. Use retained logic in preparing Schedule updates.
      g. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.
      h. Revisions to the Schedule may be included that have been previously approved as specified.

B. Monthly updates:
   1. Submit written narrative report in conjunction with each Schedule update, including descriptions of the following:
      a. Activities added to or deleted from the Schedule are to adhere to cost and other resource loading requirements.
         1) Identify added activities in manner distinctly different from original activity designations.
      b. Changes in sequence or estimated duration of activities.

c. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
d. Assumptions made and activities affected by incorporating change order work into the Schedule.
e. Include a response in writing to each of the Engineer's comments or questions from the previous month's schedule review and number responses consistent with the Engineer's numbering.

2. Submit updated Schedule and materials specified under Submittal of Progress Schedules 5 calendar days before the monthly schedule update meeting.
3. Since monthly Schedule update is the application for progress payment required as specified in Section 00622 - Contractor's Application for Payment, submittal and acceptance of the monthly Schedule update is a condition precedent to the making of any progress payments.

C. Weekly progress meeting:
1. Update the Schedule prior to weekly progress meeting.
a. Identify overall progress of each major item of work in the summary schedule.
b. If there are significant changes to the Schedule, submit a written report at the weekly progress meeting.
2. Should monthly Schedule update show project completion earlier than current Contract completion date, show early completion time as schedule activity, identified as "Project Float".
3. Should monthly Schedule update show Project completion later than current Contract completion date, prepare and submit a Schedule revision.

1.22 REVISIONS TO SCHEDULES

A. Submit revised Schedules within 5 days:
1. When delay in completion of any activity or group of activities indicates an overrun of the Contract Time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.
2. When delays in Submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
3. When the Schedule does not represent the actual progress of activities.
4. When any change to the sequence of activities, the completion date for major portions of the Work, or when changes occur which affect the critical path.
5. When Contract modification necessitates Schedule revision, submit schedule analysis of Change Order work with cost proposal.

B. Create a separate Submittal for Schedule revisions.
1. Comply with Schedule updates as specified in this Section.
2. Do not submit with Schedule updates.

C. Schedule revisions will not be reflected in the Schedule until after the revision is accepted by the Owner.
1. This includes Schedule revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.23 ADJUSTMENT OF CONTRACT TIME OR PRICE

A. Contract Time will be adjusted only for causes specified in Contract Documents.

B. If the Contractor believes that the Owner has impacted its work such that the Project completion date will be delayed, the Contractor must submit proof, in the form of a time impact analysis demonstrating the delay to the critical path.

C. Time impact analysis:
   1. Use the accepted Schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other Owner-caused delay). Represent the delay event in the Schedule by:
      a. Inserting new activities associated with the delay event into the Schedule.
      b. Revising activity logic.
      c. Revising activity durations.
   2. If the Progress Schedule's critical path and completion date are impacted as a result of adding this delay event to the Progress Schedule, a time extension equal to the magnitude of the impact may be warranted.
   3. The time impact analysis Submittal must include the following information:
      a. A fragment of the portion of the Schedule affected by the delay event.
      b. A narrative explanation of the delay issue and how it impacted the Schedule.
      c. A schedule file used to perform the time impact analysis.

D. When a delay to the Project as a whole can be avoided by revising preferential sequencing or logic and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.

E. Indicate clearly that the Contractor has used, in full, all project float available for the Work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date.
   1. Utilize the latest version of the Schedule update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.

F. Adjustment of the Contract Times will be granted only when the Contract float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date.
   1. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.

G. Actual delays in activities which do not affect the Critical Path Work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.

H. If completion of the project occurs within the specified Contract Time, the Contractor is not entitled to jobsite or home office overhead beyond the Contractor's originally planned occupancy of the site.

I. Notify Engineer of a request for Contract Time adjustment.
   1. Submit request as specified in the Contract Documents.
   2. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.

J. Engineer will, within 30 calendar days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts, and advise the Contractor in writing.
   1. Include the new Progress Schedule data, if accepted by the Owner, in the next monthly Schedule update.
   2. When the Owner has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect that amount of time adjustment in the Progress Schedule as the Engineer may accept as appropriate for such interim purpose.
   3. It is understood and agreed that any such interim acceptance by the Engineer shall not be binding and shall be made only for the purpose of continuing to schedule the Work, until such time as a final determination as to any adjustment of the Contract Time acceptable to the Engineer has been made.
   4. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

1.24 WEATHER DAY ALLOWANCE

A. Allowance:
   1. Include as a separate identifiable activity on the critical path, an activity labeled “Weather Day Allowance”.

B. Actual Weather Day:
   1. Insert a weather delay activity in the critical path to reflect actual weather day occurrences when weather days are experienced and accepted by the Engineer.
   2. Reduce duration of Weather Day Allowance activity as weather delays are experienced and inserted into the Schedule. Remaining weather days in the Weather Day Allowance at completion of the Project is considered float.
   3. Provide a written notice to the Engineer of the occurrence of a weather day within 2 days after the onset of such weather and describe in reasonable detail the type of weather encountered and the Work interfered with or interrupted.
      a. A Schedule update will not suffice as a written notice.
      b. Engineer will determine if the Weather Day constitutes a use of a portion of the Weather Day Allowance.
      c. After use of all the Weather Day Allowance, the Engineer will determine if the Contractor is entitled to an extension of the Contract Time due to weather conditions.

1.25 FINAL SCHEDULE

A. The final Schedule update becomes the As-Built Schedule.
   1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.
   2. Contractor's Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.

B. Retainage will not be released until final Schedule update is provided.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01322

WEB-BASED CONSTRUCTION DOCUMENT MANAGEMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for web-based construction document management.

1.02 REQUIREMENTS

A. Owner, Engineer, and Contractor shall utilize the specified Autodesk Build, web-based construction management software, for submission of data and documents.
   1. Web-based construction management software is available at no cost to the Contractor's personnel, subcontractor personnel, Suppliers, consultants, the Owner, and the Engineer.
   2. Joint use of this system is to facilitate electronic exchange of information, automation of key processes, and overall management of the Contract Documentation.
   3. Web based construction management software shall be the primary means of project information submission and management.

1.03 USER ACCESS LIMITATIONS

A. Provide a list of the Contractor's key web-based construction management software personnel for the Engineer's acceptance.

B. Engineer reserves the right to perform a security check on potential users.
   1. Contractor will be allowed to add additional personnel and subcontractors to the web-based construction management software.
   2. Subcontractors and Suppliers will be given access to web-based construction management software by and through the Contractor.
   3. Contractor is responsible for adding and removing users from the system after the initial setup by the Engineer.

C. Engineer will grant initial access to the web-based construction management software by creating user profiles to accepted Contractor personnel.
   1. User profiles will define levels of access into the system; determine assigned function based authorizations and user privileges.

1.04 JOINT OWNERSHIP OF DATA

A. Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the web-based construction management software system) by the Engineer and the Contractor will be jointly owned.

1.05 AUTOMATED SYSTEM NOTIFICATION AND AUDIT LOG TRACKING

A. Review comments made (or lack thereof) by the Owner on Contractor-submitted documentation shall not relieve the Contractor from compliance with requirements of the Contract Documents.

B. Contractor is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents.

C. Owner's acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the Contractor's submitted information.

1.06 COMPUTER REQUIREMENTS

A. Use computer hardware and software that meets the requirements of the web-based construction management software system as recommended by the web-based construction management software to access and utilize the web-based construction management software.

B. As recommendations are modified by the web-based construction management software, the Contractor will upgrade their system(s) to meet or exceed the recommendations.
   1. Upgrading of the Contractor's computer systems will not be justification for a cost or time modification to the Contract.

C. Ensure that connectivity to the web-based construction management software system is accomplished through DSL, cable, T-1 or wireless communications systems.
   1. Minimum bandwidth requirements for using the system is 5 Mbps. It is recommended a faster connection be used when uploading pictures and files into the system.

D. Web-based construction management software supports the current version of Chrome (preferred), Mozilla's Firefox, Microsoft Edge, and Apple's Safari on a rolling basis.
   1. Each time a new version of one of these browsers is released, the web-based construction management software will begin supporting the update and stop supporting the fourth-oldest version.

1.07 CONTRACTOR RESPONSIBILITY

A. Responsible for the validity of their information placed in the web-based construction management software and for the abilities of their personnel.

B. Entry of information exchanged and transferred between the Contractor and its subcontractors and suppliers on the web-based construction management software shall be the responsibility of the Contractor.

C. Accepted users shall be knowledgeable in the use of computers, including Internet browsers, email programs, CAD drawing applications, and Adobe Portable Document Format (PDF) document distribution program.

D. Utilize the existing forms in the web-based construction management software to the maximum extent possible. If a form does not exist in the web-based construction management software, the Contractor must include a form of their own or one provided by the Engineer as an attachment to a Submittal.

E. Adobe PDF documents will be created through electronic conversion rather than optically scanned whenever possible. Contractor is responsible for the training of their personnel in the use of the web-based construction management software (outside what is provided by the Owner) and the other programs indicated above as needed.

1.08 TRAINING

A. Owner has arranged and paid for web-based training on using web-based construction management software for the Contractor.

B. Contractor shall arrange and pay for the facilities and hardware/software required to facilitate the Contractor's training.

PART 2 PRODUCTS

2.01 DESCRIPTION

A. Web-based construction management software provided by Autodesk Build.

PART 3 EXECUTION

3.01 WEB-BASED CONSTRUCTION MANAGEMENT SOFTWARE UTILIZATION

A. Web-based construction management software shall be utilized in connection with all document and information management required by these Contract Documents.

3.02 SUBMITTALS

A. Use the web-based construction management software feature for Master Submittals List.
   1. Select from the predefined submittals list.

B. Content: As specified in Section 01330 - Submittal Procedures.

C. Format: As specified in Section 01330 - Submittal Procedures.

D. Submit Portable Document Format (PDF) documents to the web-based construction management software submittal workflow process and forms.
   1. Consolidate electronic format submittals with multiple pages into a single file.

E. Record and closeout Submittals:
   1. Operation and maintenance data as specified in Section 01770 - Closeout Procedures.
   2. Extra materials, spare parts, etc.

3.03 REQUESTS FOR INFORMATION/INTERPRETATION (RFI)

A. Use web-based construction management software for RFIs as specified in Section 01260 - Contract Modification Procedures.

3.04 OFFICIAL CORRESPONDENCE

A. Use web-based construction management software for memos, notices, change proposals, or any official correspondence.

3.05 INSPECTION REQUESTS

A. Use web-based construction management software to request inspection for a portion of Work that is ready for inspection and prior to covering up the Work.

3.06 FINANCIAL SUBMITTALS

A. Use web-based construction management software for financial Submittals as specified in Section 01330 - Submittal Procedures.

3.07 OTHER

A. Use web-based construction management software for daily reports, meeting agendas and minutes, and other construction documents.

END OF SECTION

SECTION 01330

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.

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.

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. 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.

C. Where applicable (i.e., except for Drawings, figures, etc.), Submittal content shall be electronically searchable utilizing the PDF file as submitted.

D. Thumbnails optimized for fast web viewing.

E. 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.

F. 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.

G. 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.
    a. 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
Example 1 Description	*Cast-In-Place Concrete*		*8th initial Submittal*		
	03300	-	0008		
Example 2 Description	*Cast-In-Place Concrete*		*8th initial Submittal*		*First revision to the 8th initial Submittal*
	03300	-	0008	.	1

B. Number each Submittal using a sequential numbering sequence. All Submittals must be assigned to a Specification Section.

1.05 SUBMITTALS IN ELECTRONIC MEDIA FORMAT

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

B. Text: Provide text documents and manufacturer's literature in Portable Document Format (PDF).

C. Graphics: 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 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. Approved:
        1) No Exceptions:
            a) There are no notations or comments on the Submittal and the Contractor may release the equipment for production.
        2) 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) Resubmittal not required.
        3) Make Corrections Noted - Confirm:
            a) Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
            b) 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.

b. Not Approved:
    1) Correct and Resubmit:
        a) Contractor may not proceed with the Work described in the Submittal.
        b) Contractor assumes responsibility for proceeding without approval.
        c) Resubmittal of complete Submittal package is required within 30 calendar days of the date of the Engineer's Submittal review response.
    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. Resubmittal of complete Submittal package is required with materials, equipment, methods, etc., that meet the requirements of the Contract Documents.
c. Receipt Acknowledged:
    1) Filed for Record:
        a) 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.
    2) With Comments - Resubmit:
        a) 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 15 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. Indicate project-designated equipment tag numbers for Submittal of devices, equipment, and assemblies.

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:	
Date Received PM/CM to Reviewer:	
Date Received Reviewer to PM/CM:	
Date Sent PM/CM to GC:	

SECTION 01331

SUBMITTAL FORMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Submittal Transmittal Forms as specified in Attachment A - Contractor Submittal Transmittal Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - CONTRACTOR SUBMITTAL TRANSMITTAL FORM

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

Owner:	South Valley Water Reclamation Facility	**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:

In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.

Firm: Click here to enter text. **Signature:** **Date Returned:** XX/XX/XXXX

PM/CM Office Use	
Date Received GC to PM/CM:	
Date Received PM/CM to Reviewer:	
Date Received Reviewer to PM/CM:	
Date Sent PM/CM to GC:	

SECTION 01357

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 00800 - 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. Submit as specified in Section 01330 - Submittal Procedures.

B. 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.

C. 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) Group items within each "area" as follows:
                a) Systems.
                b) Components.
                c) Supports.
                d) Anchorage.
                e) Bracing.

D. 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 01410

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Regulatory authorities and codes.

1.02 AUTHORITIES HAVING JURISDICTION (AHJ)

A. Also referred to as the permitting agency.

B. Building Department: West Jordan Building and Safety Division.

C. Fire Department: West Jordan Fire Department.

1.03 APPLICABLE CODES

A. International Code Council (ICC).
   1. Building code:
      a. International Building Code (IBC).
      b. International Existing Building Code (IEBC), 2021.
   2. Electrical code:
      a. National Fire Protection Association (NFPA), NFPA 70: National Electrical Code (NEC), 2020.
   3. Energy code:
      a. International Energy Conservation Code (IECC), 2021.
   4. Fire code:
      a. International Fire Code (IFC), 2021.
   5. Fuel gas code:
      a. International Fuel Gas Code (IFGC), 2021.
   6. Mechanical code:
      a. International Mechanical Code (IMC), 2021.
   7. Plumbing code:
      a. International Plumbing Code (IPC), 2021.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01450

QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. General requirements for Quality Control.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.

B. Comply with the manufacturers' instructions.

C. When the manufacturers' instructions conflict with the Contract Documents, request clarification from the Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work, except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Work shall be performed by qualified persons.

F. Verify field measurements are as indicated on the Drawings or as instructed by the manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products.

B. Comply with the manufacturers' tolerances. When the manufacturers' tolerances conflict with the Contract Documents, request clarification from the Engineer before proceeding.

C. Adjust products locations to maintain appropriate dimensions; confirm position before securing products in place.

1.04 REFERENCES

A. ASTM International (ASTM):
   1. E329 - Standard for Agencies Engaged in Construction Inspection, Testing or Special Inspection.

B. National Institute of Standards and Technology (NIST).

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01455

REGULATORY QUALITY ASSURANCE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Project regulatory requirements for quality assurance that includes Special Inspections, Special Certification, and Structural Observation.

B. Special Certification and Special Inspections in this Section are in addition to the requirements specified in Section 01450 - Quality Control, and in the individual Sections.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete.
   2. 530 - Building Code Requirements for Masonry Structures.
   3. 530.1 - Specification for Masonry Structures.

B. American Institute of Steel Construction (AISC):
   1. 360 - Specification for Structural Steel Buildings.

C. American Society of Civil Engineers (ASCE):
   1. 7 - Minimum Design Loads for Buildings and Other Structures.

D. American Welding Society (AWS):
   1. D1.3 - Structural Welding Code - Sheet Steel.
   2. D1.4 - Structural Welding Code - Reinforcing Steel.

E. ASTM International (ASTM):
   1. A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
   2. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   3. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
   4. C1611 - Standard Test Method for Slump Flow of Self-Consolidating Concrete.

F. Building Code:
   1. As specified in Section 01410 - Regulatory Requirements.

G. The Masonry Society (TMS):
   1. 402 - Building Code for Masonry Structures.
   2. 602 - Specifications for Masonry Structures.

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. Special Certification: Certification for designated seismic systems that demonstrates compliance with performance requirements.
   2. Special Inspection: Inspection of the materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards.
   3. Special Inspection, Continuous: The full-time observation of work requiring Special Inspection by an approved special inspector who is present in the area where the work is being performed.
   4. Special Inspection, Periodic: The part-time, or intermittent observation of work requiring Special Inspection by an approved special inspector who is present in the area where the work is being performed and at the completion of the work.
   5. Structural Observation: The visual observation of the structural system by a registered design professional for general conformance to the approved construction documents at significant construction stages and at completion of the structural system.

1.04 SUBMITTALS

A. Submit Special Certifications for designated seismic systems.

B. Schedule and coordinate the submittal of Special Inspection reports and test results prepared by others.

1.05 SPECIAL INSPECTION

A. Owner will employ one or more special inspectors who will provide Special Inspections during construction.

B. Special inspector(s) shall be qualified for inspection of the particular type of materials or operations requiring Special Inspection.

C. Duties of special inspector:
   1. General: Required duties of the special inspector(s) shall be as described in the Building Code.
   2. Reporting: Special inspector(s) shall provide reports of each inspection to the Owner and shall distribute copies of inspection reports to the Engineer and Contractor as required.
      a. Reports shall, at a minimum, include the following items:
         1) Date and time of inspection, and name(s) of individual(s) performing the inspection.
         2) Structures and areas of the structure where work or testing was observed.
         3) Discrepancies between the requirements of the Contract Documents and the work or testing observed.
         4) Other areas of deficiency in the Work.

D. Special Inspections shall not be construed as fulfilling the requirements for Structural Observation.

E. Owner or special inspector will select materials for Special Inspection.
   1. Contractor shall not select materials for Special Inspection.

1.06 SPECIAL CERTIFICATION

A. Provide equipment that meets the special certification requirements of the Building Code.

B. Designated seismic systems shall be subject to the testing and qualification requirements of the regulatory Building Code, and shall require Special Certification as set forth in ASCE 7:
   1. Mechanical equipment that is assigned an importance factor of 1.50 as specified in Section 01850 - Design Criteria.
   2. All electrical equipment.

C. Special certification requirements for designated seismic systems:
   1. Submittals shall include certification that the equipment is seismically qualified. Certifications are subject to review and acceptance by Owner.
   2. Certifications may be at least one of the following in accordance with ASCE 7:
      a. Analysis.
      b. Testing.
      c. Experience data.

1.07 STRUCTURAL OBSERVATION

A. Owner will employ one or more registered design professionals to provide Structural Observation(s) during construction.
   1. Registered design professional will be a civil or structural engineer currently licensed as such in the state where the project is located and regularly engaged in structural design equivalent to or similar to that indicated on the Drawings.

B. Structural Observations shall not be construed as fulfilling the requirements for Special Inspections.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SPECIAL INSPECTIONS

A. Owner will provide Special Inspection of the following types of work as described in the Building Code wherever such work occurs, unless otherwise specified.
   1. Attachment A - Concrete - Special Inspection Schedule.
   2. Attachment B - Architectural, Mechanical, and Electrical Components - Special Inspection Schedule.

3. Attachment C2 - Masonry Special Inspection Schedule - Level 3.
4. Attachment E - Structural Steel Welding - Special Inspection Schedule.
5. Attachment F - Structural Steel Bolting - Special Inspection Schedule.

3.02 SPECIAL CERTIFICATION

A. Special inspector shall examine the designated seismic system(s) and determine whether the designated system components, including anchorage, are consistent with the evidence of compliance submitted for Special Certification.

3.03 STRUCTURAL OBSERVATION

A. The following work requires Structural Observation in accordance with the Building Code.
   1. Conduit Rack.

3.04 SCHEDULE

A. Allow time necessary for Special Inspections and Structural Observation specified in this Section.

B. Sufficient notice shall be given so that the Special Inspections and Structural Observations can be performed. Allow time for individuals performing to travel to the Site.

3.05 PROCEDURE

A. Special inspector will immediately notify the Engineer of any corrections required and follow notification with appropriate documentation.

B. Contractor shall not proceed until the Work is satisfactory to the Engineer.

END OF SECTION

ATTACHMENT A - CONCRETE - SPECIAL INSPECTION SCHEDULE

CONCRETE - SPECIAL INSPECTION SCHEDULE
(Includes: Cast-in-place)

Verification and Inspection	Reference Standard	Frequency of Inspection[(1)] (During Task Listed)	
		Continuous	Periodic
1. Inspect anchors post-installed in hardened concrete members:			
a. Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads.	ACI 318	●	
b. Mechanical anchors and adhesive anchors not defined in 4.a.	ACI 318		●

Notes:

(1) ● Represents a required inspection activity for the project where it occurs.

ATTACHMENT B - ARCHITECTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS - SPECIAL INSPECTION SCHEDULE

ARCHITECTURAL, MECHANICAL, AND ELECTRICAL COMPONENTS - SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection[1] (During Task Listed)	
		Continuous	Periodic
1. Architectural components:			
a. Storage racks - 8 feet or greater in height: Anchorage.	Building Code		●
2. Plumbing, mechanical, and electrical components:			
a. Anchorage of electrical equipment for emergency and standby power systems.	Building Code		●
b. Anchorage of other electrical and mechanical equipment over 400 lb. on floors or roofs.	Building Code		●
c. Installation and anchorage of ductwork designed to carry hazardous materials.	Building Code		●
d. Installation and anchorage of ductwork greater than 6 sf in cross-section.			●
e. Installation of mechanical and electrical equipment, including ductwork, piping systems and their structural supports, where automatic fire sprinkler systems are installed.	Building Code		●
3. Fire-resistance elements:			
a. Sprayed fire-resistant coatings.	Building Code		
b. Mastic and intumescent coatings.	Building Code		
c. Fire-resistant penetrations and joint systems.	Building Code		
4. Smoke control systems.	Building Code		

Notes:

(1) ● Represents a required inspection activity for the project where it occurs.

ATTACHMENT C2 - MASONRY SPECIAL INSPECTION SCHEDULE - LEVEL 3

MASONRY SPECIAL INSPECTION SCHEDULE - LEVEL 3

MINIMUM TESTS

Verification of proportions of materials in premixed or pre-blended mortar and grout as delivered to the Project Site.

MINIMUM SPECIAL INSPECTION - LEVEL 3			
Verification and Inspection	**Reference Standard**	**Frequency of Inspection(1) (During Task Listed)**	
		Continuous	**Periodic**
1. Verify compliance with the approved submittals.	TMS 602/ACI 530.1		●
2. Prior to grouting, verify that the following are in compliance:			
a. Grade, type, and size of reinforcement and anchor bolts.	TMS 602/ACI 530.1 TMS 402/ACI 530		●
b. Grade, size, and placement of reinforcement, connectors, and anchors.	TMS 602/ACI 530.1 TMS 402/ACI 530	●	
3. Verify during construction:			
a. Materials and procedures with the approved submittals.	TMS 602/ACI 530.1		●
b. Type, size, and location of anchors, including details of anchorage of masonry to structural members, frames, or other construction.	TMS 402/ACI 530	●	
Notes: (1) ● Represents a required inspection activity for the project where it occurs.			

ATTACHMENT E - STRUCTURAL STEEL WELDING - SPECIAL INSPECTION SCHEDULE

STRUCTURAL STEEL WELDING - SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection[1] (During Task Listed)	
		Continuous	Periodic
Inspection Tasks Prior to Welding	AISC 360		
1. Welding procedure specifications (WPSs) available.		●	
2. Manufacturer certifications for welding consumables available.		●	
3. Material identification (type/grade).			●
4. Welder identification system.			●
5. Fit-up groove welds (including joint geometry): • Joint preparation. • Dimensions (alignment, root opening, root face, bevel). • Cleanliness (condition of steel surfaces). • Tacking (tack weld quality and location). • Backing type and fit (if applicable).			●
6. Configuration and finish of access holes.			●
7. Fit-up of fillet welds: • Dimensions (alignment, gaps at root). • Cleanliness (condition of steel surfaces). • Tacking (tack weld quality and location).			●
8. Check welding equipment.			●
Inspection Tasks During Welding	AISC 360		
9. Use of qualified welders.			●
10. Control and handling of welding consumables: • Packaging. • Exposure control.			●
11. No welding over cracked tack welds.			●
12. Environmental conditions: • Wind speed within limits. • Precipitation and temperature.			●
13. WPS followed: • Settings on welding equipment. • Travel speed. • Selected welding materials. • Shielding gas type/flow rate. • Preheat applied. • Interpass temperature maintained (min/max). • Proper position (F, V, H, OH).			●

Verification and Inspection	Reference Standard	Frequency of Inspection[1] (During Task Listed)	
		Continuous	Periodic
14. Welding techniques: • Interpass and final cleaning. • Each pass within profile limitations. • Each pass meets quality requirements.			●
Inspection Tasks After Welding	AISC 360		
15. Welds cleaned.			●
16. Size, length, and location of welds.		●	
17. Welds meet visual acceptance criteria: • Crack prohibition. • Weld/base-metal fusion. • Crater cross-section. • Weld profiles. • Weld size. • Undercut. • Porosity.		●	
18. Arc strikes.		●	
19. k-area.		●	
20. Backing removed and weld tabs removed (if required).		●	
21. Repair activities.		●	
22. Document acceptance or rejection of welded joint or member.		●	
Notes: (1) ● Represents a required inspection activity for the project where it occurs.			

ATTACHMENT F - STRUCTURAL STEEL BOLTING - SPECIAL INSPECTION SCHEDULE

STRUCTURAL STEEL BOLTING - SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard	Frequency of Inspection[1] (During Task Listed)	
		Continuous	Periodic
Inspection Tasks Prior to Bolting	AISC 360		
1. Manufacturer's certifications available for fastener materials.		●	
2. Fasteners marked in accordance with ASTM requirements.			●
3. Proper fasteners selected for the joint detail (grade, type, bolt length if threads are to be excluded from shear plane).			●
4. Proper bolting procedure selected for joint detail.			●
5. Connecting elements, including the appropriate faying surface condition and hole preparation, if specified, meet applicable requirements.			●
6. Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used.			●
7. Proper storage provided for bolts, nuts, washers and other fastener components.			●
Inspection Tasks During Bolting	AISC 360		
8. Fastener assemblies, of suitable condition, placed in all holes and washers (if required) are positioned as required.			●
9. Joint brought to the snug-tight condition prior to the pretensioning operation.			●
10. Fastener component not turned by the wrench prevented from rotating.			●
11. Fasteners are pretensioned in accordance with the RCSC Specification, progressing systematically from the most rigid point toward the free edges.			●
Inspection Tasks After Bolting	AISC 360		
12. Document acceptance or rejection of bolted connections.		●	

Notes:

(1) ● Represents a required inspection activity for the project where it occurs.

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Furnishing, maintaining, and removing construction facilities and temporary controls.

1.02 REFERENCE

A. American National Standards Institute (ANSI).

B. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

1.04 TEMPORARY UTILITIES

A. Temporary electrical power:
   1. Owner provides the utility power.
   2. The Contractor shall supply temporary generators for power as specified in Section 01030 - Special Project Constraints.

B. Temporary electrical lighting:
   1. In work areas, provide temporary lighting sufficient to maintain lighting levels during working hours not less than lighting levels required by OSHA and state agency which administers OSHA regulations where Project is located.
   2. When available, permanent lighting facilities may be used in lieu of temporary facilities:
      a. Prior to Substantial Completion of the Work, replace bulbs, lamps, or tubes used by Contractor for lighting.

C. Temporary heating, cooling, and ventilating:
   1. Heat and ventilate work areas to protect the Work from damage by freezing, high temperatures, weather, and to provide safe environment for workers.
   2. Permanent heating system may be utilized when sufficiently completed to allow safe operation.

D. Temporary sanitary facilities:
   1. Provide suitable and adequate sanitary facilities that are in compliance with applicable Laws and Regulations.
   2. Existing facility use is not allowed.
   3. At completion of the Work, remove sanitary facilities and leave site in neat and sanitary condition.

E. Temporary fire protection:
   1. Provide fire protection required to protect the Work and ancillary facilities.

F. First aid: Post first aid facilities and information posters conforming to requirements of OSHA and other applicable Laws and Regulations in readily accessible locations.

G. Utilities in existing facilities: As specified in Section 01140 - Work Restrictions.

1.05 CONSTRUCTION AIDS

A. Provide railings, kick plates, enclosures, safety devices, and controls required by Laws and Regulations and as required for adequate protection of life and property.

B. Use construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities of ample size and capacity to adequately support and move loads.

C. Design temporary supports with adequate safety factor to ensure adequate load bearing capability:
   1. When requested, submit design calculations by professional registered engineer prior to application of loads.
   2. Submitted design calculations are for information and record purposes only.

D. Accident prevention:
   1. Exercise precautions throughout construction for protection of persons and property.
   2. Observe safety provisions of applicable Laws and Regulations.
   3. Guard machinery and equipment and eliminate other hazards.
   4. Make reports required by authorities having jurisdiction, and permit safety inspections of the Work.
   5. Before commencing construction work, take necessary action to comply with provisions for safety and accident prevention.

E. Protect existing structures and other items to be preserved on Project site from injury, damage, or destruction by vehicles, equipment, worker or other agents with substantial barricades or other devices commensurate with hazards.

1.06 SECURITY

A. Make adequate provision for protection of the work area against fire, theft, and vandalism, and for protection of public against exposure to injury.

1.07 ACCESS ROADS

A. On-site access roads:
   1. Maintain access roads to storage areas and other areas to which frequent access is required.
   2. Maintain similar roads to existing facilities on site of the Work to provide access for maintenance and operation.
   3. Maintain on-site access roads free of mud.

1.08 TEMPORARY CONTROLS

A. Noise control:
   1. Comply with noise and work hours regulations by local jurisdiction.
   2. In or near inhabited areas, particularly residential, perform operations in manner to minimize noise.
   3. In residential areas, take special measures to suppress noise during night hours.

1.09 REMOVAL

A. Remove temporary facilities and controls before inspection for Substantial Completion or when directed.

B. Clean and repair damage caused by installation or use of temporary facilities.

C. Restore existing facilities used during construction to specified or original condition.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01520

SECURITY AND PROCESS SAFETY MANAGEMENT

PART 1 GENERAL

1.01 SECURITY PROGRAM

A. The Contractor shall:
   1. Protect Work, existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
   2. Maintain program throughout construction period.
   3. Require that the workers employed by the Contractor, his Subcontractors and his Vendors shall obey all Rules and Ordinances enacted by the SVWRF regarding the existence of firearms on SVWRF property.
      a. The Contractor shall immediately suspend any such worker who disobeys said Rules and Ordinances and remove such worker from the SVWRF property.

1.02 ENTRY CONTROL

A. The Contractor shall:
   1. Limit entry of persons and vehicles into project site.
   2. Allow entry only to authorized persons.
   3. Require that all personal vehicles of the workers employed by the Contractor, his Subcontractors and his Vendors shall park their cars outside of the SVWRF property enclosed by SVWRF gates and fencing.
      a. At his option, the Contractor may construct a temporary parking facility on the Owner's property southwest of the main SVWRF entry gate to be used by the workers.
   4. Entry to the SVWRF facility by the workers of the Contractor, his Subcontractors and his Vendors may be by walking through the front gate or by official shuttle bus operated by the Contractor.

B. Owner will control entrance of persons and vehicles related to Owner's operations.

C. The Contractor's and all Subcontractor's personnel shall report at the Lower Maintenance Building at the start and the end of the workday.
   1. Each person shall sign the daily roll log and indicate the time of sign-in and sign-out.
   2. The RPR will copy the daily roll log and submit to the Owner's designated person to monitor for Process Safety Management purposes.

1.03 PERSONNEL IDENTIFICATION

A. The Contractor shall:
   1. Maintain al list of authorized persons and submit copy to Owner on request.
   2. Require that an identifying badge shall be worn by each of the workers of the Contractor, his subcontractors and Vendors on the front of their construction

hard hats. Further, the Contractor shall collect the Driver's License of each worker as he first comes on-site and submit them to the RPR.

a. The RPR will oversee the production of the badges and will return the Driver's Licenses with Badges to the Contractor's Project Superintendent.

1.04 PROCESS SAFETY MANAGEMENT PLAN

A. The Contractor shall conform to the Owner's Process Safety Management Plan which is available for review from the Owner's designated Safety officer.

B. Hot Work Permit. The Contractor's personnel shall obtain a Hot Work Permit when conducting work on any existing electrical equipment.

1. Hot Work permits shall be completed daily by each employee and counter-signed by the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for products.

1.02 TERMINOLOGY

A. The words and terms listed below, are not defined terms that require initial capital letters, but, when this Section is referenced in other Specifications, have the indicated meaning.
   1. Manufacturer's instructions:
      a. Stipulations, directions, and/or recommendations issued by the manufacturer of the product addressing handling, storage, installation, protection, erection, and/or application of the product.
   2. Product data:
      a. Information about the product, typically found in the manufacturer's catalogs specifications or other resources, including data sheets, bulletins, and brochures.
   3. Spare parts and maintenance products:
      a. Duplicate parts necessary to replace a damaged or worn part of the product.
      b. Consumables such as operating fluids.
   4. Special tools:
      a. Special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a product that would not normally be in the Owner's tool kit and that have been specifically made for use on a product for assembly, disassembly, repair, or maintenance.

1.03 SHIPMENT

A. Requirements prior to shipment of equipment:
   1. Engineer approved Submittals or other written documentation allowed by the Contract Documents.

B. Transport products by methods that avoid product damage.

C. Deliver products in undamaged condition in the manufacturer's unopened packaging.

1.04 DELIVERY AND HANDLING

A. Handle products in accordance with the manufacturer's instructions.

B. Deliver products in undamaged condition in the manufacturer's unopened packaging.

C. Provide construction equipment and personnel to handle products by methods in accordance with the manufacturer's instructions.

D. Upon delivery, promptly inspect shipments:
   1. Verify compliance with the Contract Documents, correct quantities, and undamaged condition of products.
   2. Acceptance of shipment does not constitute final acceptance of products.

1.05 STORAGE

A. Immediately store and protect products until installed in the Work.

B. Store products with seals and legible labels intact.

C. Protect painted or coated surfaces against impact, abrasion, discoloration, and damage.

D. Storage of equipment in accordance with the manufacturer's instructions.
   1. Furnish a copy of the manufacturer's instructions for storage to the Engineer prior to storage of equipment and materials.

E. Furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for electrical and instrumentation equipment.

F. Exterior storage of fabricated products:
   1. Place on aboveground supports that allow for drainage.
   2. Cover products subject to deterioration with impervious sheet covering.
   3. Provide ventilation to prevent condensation under covering.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide products by the same manufacturer when units are of similar nature, unless otherwise specified.

B. Provide like parts of duplicate units that are interchangeable.

C. Provide equipment or products that have not been in service prior to delivery, except as required by tests.

D. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
   1. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

E. Provide products produced by manufacturers regularly engaged in the production of these products.

F. Provide products that bear approvals and labels as specified such as Factory Mutual (FM), Underwriters Laboratory (UL), or National Sanitation Foundation (NSF International) that are acceptable to the Authority Having Jurisdiction.

2.02 MATERIAL

A. Dissimilar metals:
   1. Separate contacting surfaces with dielectric material.
   2. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators, washers, petrolatum tape, or other materials as specified.
   3. Dielectric coatings can be used to separate dissimilar metal couples from surrounding environment if isolation of metals is not possible, with approval of the Engineer.

2.03 PRODUCT SELECTION

A. When products are specified without named manufacturers, provide products that meet or exceed the Specifications.

B. When products are specified with names of manufacturers but no model numbers or catalog designations, provide products by one of the named manufacturers that meet or exceed specifications.

C. When products are specified with names of manufacturers and model numbers or catalog designations, provide products with model numbers or catalog designations by one of the named manufacturers.

2.04 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. Provide spare parts and maintenance products as required by Technical Sections.
   1. Submit completed Attachment A - Spare Parts, Maintenance Products, and Special Tools Inventory List.

B. Provide 1 set of special tools required to install or service the equipment.

C. Prior to Substantial Completion, arrange to deliver spare parts, maintenance products, and special tools to the Owner at a location on site, chosen by the Owner.
   1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
   2. Owner and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.

D. Contractor is responsible for spare parts, maintenance products, and special tools until acceptance by the Owner.

PART 3 EXECUTION

3.01 INSTALLATION

A. Inspect equipment or products prior to installation.

B. Repaint or recoat damaged painted or coated surfaces after installation.

C. Use anti-galling compound on stainless steel threads used for field assembly.

3.02 PROTECTION AFTER INSTALLATION

A. Provide coverings as necessary to protect installed products from damage due to traffic and subsequent construction operations.
   1. Remove covering when no longer needed.
   2. Replace corroded, damaged, or deteriorated products before acceptance of the Project.

B. Update equipment log with monthly pay applications.
   1. Data includes as a minimum: Description of maintenance activities performed in accordance with the manufacturer's recommendation and industry standards and signature of party performing maintenance.

END OF SECTION

ATTACHMENT A - SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

Owner: _____ **Date:** _____

Contractor: _____ **Project No.:** _____

Project Name: _____

Inventory List				
Spec Number: _____		Spec Title: _____		
Equipment Tag No.: _____		Equipment Manufacturer: _____		
Quantity	**Subassembly Component**	**Description**	**Manufacturer's Part Number**	**Storage Location**

SECTION 01738

SELECTIVE ALTERATIONS AND DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cutting or modifying of existing and new work.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. A10.6 - Safety and Health Program Requirements for Demolition Operations.

B. International Concrete Repair Institute (ICRI):
   1. Guideline No. 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
   2. Guideline No. 310.3R - Guide for the Preparation of Concrete Surfaces for Repair Using Hydrodemolition Methods.

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. Chipping hammer:
      a. A hand-operated electrical or pneumatic demolition device for removal of hardened concrete or masonry materials having a weight of less than 15 pounds and an impact frequency of greater than 2,000 blows per minute.
   2. Concrete breaker:
      a. A hand-operated electrical or pneumatic demolition device for removal of hardened concrete or masonry materials having a weight greater or impact frequency less than the limits defined for a chipping hammer.
   3. Coring equipment: Non-impact rotary drill with diamond cutting edges.
   4. Heavy abrasive blast:
      a. Cleaning procedure by which various abrasives materials, or steel shot, are forcibly propelled by high pressure against a surface to remove loose material and produce a concrete surface roughened to ICRI Surface Profile CSP-7, or higher, as specified in ICRI 301.3R.
   5. Salvage material: Materials removed from existing facilities and stored for the Owner’s future reuse.

1.04 DESCRIPTION OF WORK

A. The Work includes partial demolition, cutting, and modifying of existing facilities, utilities, and/or structures.

B. These facilities may be occupied and/or operational. Satisfactory completion of the Work will require:
   1. Planning activities carefully to work around unavoidable obstacles and to maintain overall stability of structures and structural elements.
   2. Restoration of existing facilities, utilities, and structures that are to remain in place and that are damaged by demolition or removal operations.

1.05 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. Shop Drawings:
   1. Show the location of all embedded items using diagrams and/or other media that clearly show dimensions and locations of existing structural elements, existing embedded items and any new embedded items and their relationship to each other.

C. Selective demolition plan:
   1. Prepare a comprehensive selective demolition plan for the Work, including the following elements, at a minimum:
      a. Proposed sequence, methods, temporary support, and equipment for demolition, removal, and disposal of portions of structure(s).
      b. Provisions and procedures for salvage and delivery to the Owner of salvaged items, if required.
   2. Submit plan a minimum of 4 weeks before demolition is scheduled to begin.

D. Submittals for record only:
   1. Permit for transport and disposal of debris.
   2. Selective demolition plan.

E. Quality Assurance Submittals:
   1. Qualifications of non-destructive testing agency/agencies.

F. Project Record Documents:
   1. As specified in Section 01770 - Closeout Procedures.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Assign relocation, removal, cutting, coring, and patching to trades and workers qualified to perform the Work in manner that causes the least damage and that provides means of returning surfaces to an appearance at least equal to that of the surrounding areas unaffected by the Work.
   2. Non-destructive testing agencies:
      a. Minimum of 5 years' experience performing non-destructive testing for location of steel reinforcement in existing concrete under conditions similar to that required for this Work.

1.07 SEQUENCING

A. Perform Work in sequences and within times specified in Section 01140 - Work Restrictions.

B. Owner will cooperate to assist in expediting the Work.

C. Coordinate the Work with operation of the facility:
   1. If the facility or utility to be modified cannot be removed from service, perform the Work while the facility is in operation using procedures and equipment that do not jeopardize operation or materially reduce the efficiency the facility.
   2. Do not begin alterations of designated portions of the Work until specific permission for activities in each area has been granted by the Owner in writing.
   3. Operational functions of the facility that are required to be performed to facilitate the Work will be performed by facility personnel only.
   4. Complete Work as quickly and with as little delay as possible.
      a. When necessary for the proper operation or maintenance of portions of the facility, reschedule operations so the Work will not conflict with required operations or maintenance.

1.08 REGULATORY REQUIREMENTS

A. Dispose of debris in accordance with governing regulatory agencies.

B. Comply with applicable air pollution control regulations.

1.09 PROJECT CONDITIONS

A. Do not interfere with use of adjacent structures and elements of the facility not subject to the Work described in this Section. Maintain free and safe passage to and from such facilities.

B. Provide, erect, and maintain barricades, lighting, guardrails, and protective devices as required to protect building occupants, workers, and adjoining property:
   1. Do not close or obstruct roadways without permission of the Owner.
   2. Conduct operations with minimum interference to public or private roadways.
   3. Cease operations and notify the Engineer immediately when the safety of structures appears to be endangered.
      a. Take precautions to properly support structure.
      b. Do not resume operations until safety is restored.
   4. Assume liability for movement, settlement, or collapse. Promptly repair damage.

C. Unknown conditions:
   1. Drawings may not represent all conditions at the Site and adjoining areas. Compare actual conditions with Drawings before commencement of Work.
   2. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under

construction, notify the Engineer in writing, requesting instructions on their disposition.

a. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the Work until written instructions are received from the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to beginning selective demolition operations, perform a thorough inspection of the facility and Site.
   1. Report to the Engineer defects, structural damage, and deterioration of existing construction to remain in place.

B. Examine areas affected by the Work and verify the following conditions prior to commencing demolition:
   1. Disconnection of utilities as required.
   2. Verify that utilities serving occupied or active portions of surrounding facilities will not be disturbed, except as otherwise indicated.

C. If unsatisfactory conditions exist, notify the Engineer, and do not begin demolition operations until such conditions have been corrected.

3.02 PREPARATION

A. Plan and organize Work to minimize inconvenience to plant operations.

B. Non-destructive evaluation of existing concrete and masonry:
   1. Prior to cutting, drilling, coring, and/or any other procedure that penetrates existing concrete or masonry, retain and pay for the services of a qualified non-destructive testing agency to perform investigations to determine the location of existing steel reinforcement, plumbing, conduit, and/or other embedments in the concrete.
   2. Submit documentation of the investigations to the Engineer for review and approval as specified in Section 01330 - Submittal Procedures, before any work involving penetration of existing concrete is initiated.

C. Protection:
   1. Provide temporary heat, cooling, and humidity control as necessary to prevent damage to existing and new equipment and construction.
   2. Maintain existing exiting paths and/or provide new paths in accordance with Building Code requirements.
   3. Erect and maintain dustproof partitions as required to prevent spread of dust to other parts of building. Maintain negative pressure in the area where the Work is being performed to prevent the accidental spread of dust and to minimize the spread of fumes related to the Work.

4. Upon completion of the Work, remove dustproof partitions.
5. Repair damaged surfaces to match adjacent surfaces.
6. Provide and maintain protective devices to prevent injury from falling objects.
7. Locate guardrails in stairwells and around open shafts to protect workers. Post clearly visible warning signs.
8. Protect the following from damage or displacement during the Work.
    a. Existing construction that will remain in place.
9. Carefully remove designated materials and equipment to be salvaged by the Owner or reinstalled.
10. Store and protect materials and equipment to be reinstalled.

D. Layout:
1. The limits of selective demolition are indicated on the Drawings. Confine demolition operations within the limits indicated on the Drawings.
2. Lay out demolition and removal work at the Site and coordinate with related work for which demolition and removal is required.
3. Arrange for the Engineer's inspection of the layout extents.
4. Do not begin demolition/removal operations until the layout markings have been reviewed by the Engineer.

3.03 DEMOLITION

A. General:
1. Perform demolition work in accordance with ANSI A10.6.
2. Conduct demolition and removal work in a manner that will minimize dust and flying particles.
3. Remove materials carefully, to the extent indicated and as required.
    a. Provide neat and orderly junctions between existing and new materials.
    b. Use methods that terminate surfaces in straight lines at natural points of division.
4. Do not remove anything beyond the limits of the Work indicated without prior written authorization from the Engineer.
    a. If in doubt about whether to remove an item, obtain written authorization from the Engineer prior to proceeding.
5. Perform Work so as to provide the least interference and most protection to existing facilities to remain.
6. Demolished materials:
    a. Assume possession of materials unless otherwise indicated on the Drawings or specified.
    b. Remove demolished materials from the Site at least weekly and dispose of them in accordance with laws and regulations.

B. Demolition of concrete and masonry:
1. Demolish in small sections.
    a. Perform demolition with small tools as much as possible.

C. Remove demolished materials, tools, and equipment upon completion of demolition.

3.04 RESTORATION

A. General:
   1. Repair damage caused by demolition to conditions equal to those that existed prior to beginning of demolition.
      a. Patch and replace portions of existing finished surfaces that are damaged, lifted, and discolored.
         1) Refinish patched portion surfaces in a manner which produces uniform color and texture to entire surface, and that matches color and texture of adjacent surfaces.
      b. When existing finish cannot be matched, refinish entire surface to nearest change of plane where the angle of change exceeds 45 degrees.
   2. Cost of repairs shall be at the Contractor's expense at no increase in the Contract Price.
   3. When new construction abuts or finishes flush with existing construction, make smooth transitions. Match finish of existing construction.

B. Restore areas affected by removal of existing equipment, equipment pads and bases, piping, supports, electrical panels, electric devices, conduits, and fasteners so little or no evidence of the previous installation remains:
   1. After removal of piping, conduit, fasteners, and other construction, fill areas in existing concrete and masonry as indicated on the Drawings.
   2. Finish surfaces exposed in the finished Work to match the surrounding surfaces.

C. Terminate abandoned conduits with blind flanges, caps, or plugs.
   1. Secure closures in place.

D. Where existing fasteners projecting from concrete and masonry are not to be retained, cut off and repair as specified in the preceding paragraphs for reinforcement.

3.05 FIELD QUALITY CONTROL

A. Do not proceed with demolition without the Engineer's inspection of the layout.

B. Do not deviate from the submitted demolition plan without notifying the Engineer prior to the Work.

END OF SECTION

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Contract closeout requirements.

1.02 REFERENCES

A. American Water Works Association (AWWA).

1.03 FINAL CLEANING

A. Perform final cleaning prior to inspections for Substantial Completion.

B. Employ skilled workers who are experienced in cleaning operations.

C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.

D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.

E. Remove dust, cobwebs, and traces of insects and dirt.

F. Clean dust, dirt, stains, fingerprints, paint, blemishes, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.

G. Remove non-permanent protection and labels.

H. Clean permanent filters and replace disposable filters when heating, ventilation, and air conditioning units were operated during construction.

I. Clean ducts, blowers, and coils when units were operated without filters during construction.

J. Clean light fixtures.

1.04 WASTE DISPOSAL

A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
   1. Prior to making disposal on private property, obtain written permission from the Owner of such property.

B. Do not create unsightly or unsanitary nuisances during disposal operations.

C. Maintain disposal site in safe condition and good appearance.

D. Complete leveling and cleanup prior to final completion of the Work.

1.05 TOUCH-UP AND REPAIR

A. Touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Substantial Completion.

B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.06 CLOSEOUT DOCUMENTS

A. Submit the following before Substantial Completion:
   1. Punch list of items to be completed or corrected with the request for issuance of Substantial Completion.
   2. Project Record Documents.
   3. Approved Operation and Maintenance Manuals.
   4. Approved Warranties and Bonds.
   5. Completed Contract requirements for Commissioning and process Start-Up.

B. Submit the following before final completion of the Work and at least 7 days prior to submitting Application for Final Payment:
   1. Punch list items have been completed and the Engineer and Owner are satisfied that all deficiencies are corrected.
   2. Evidence of Payment and Release of Liens or Stop Payment Notices as outlined in Conditions of the Contract.
   3. Release of claims as outlined in Conditions of the Contract.
   4. Submit certification of insurance for products and completed operations, as specified in the General Conditions.
   5. Final statement of accounting.
   6. Submit Final (As-Built) Schedule as specified in Section 01321 - Schedules and Reports.

1.07 PROJECT RECORD DOCUMENTS

A. Maintain at the Project Site, available to the Owner and Engineer, 1 copy of the Contract Documents, Shop Drawings, and other Submittals in good order:
   1. Mark and record field changes and detailed information contained in Submittals and Change Orders.
   2. Identify the final locations of equipment, electrical conduits, and pull boxes.
   3. Provide schedules, lists, layout drawings, and wiring diagrams.
   4. Make annotations in electronic format or hard copy format with erasable colored pencil in accordance with the following color code:

Additions:	Red
Deletions:	Green
Comments	Blue
Dimensions:	Graphite

B. Maintain documents separate from those used for construction:
   1. Label documents “RECORD DOCUMENTS.”

C. Keep documents current:
   1. Record required information at the time the material and equipment is installed and before permanently concealing.
   2. Engineer will review Record Documents weekly to ascertain that changes have been recorded.

D. Deliver Record Documents with transmittal letter containing date, Project title, Contractor’s name and address, list of documents, and signature of the Contractor.

E. Record Documents will be reviewed monthly to determine the percent complete for the monthly pay application.

F. Updated Record Documents are a condition for the Engineer’s recommendation for progress payment.

G. Final Schedule Submittal as specified in Section 01321 - Schedules and Reports.

1.08 MAINTENANCE SERVICE

A. As specified in Technical Specifications.

1.09 SUBSTANTIAL COMPLETION

A. Obtain Certificate of Substantial Completion.

1.10 FINAL COMPLETION

A. When Contractor considers the Work is complete, submit written certification that:
   1. Work has been completed in accordance with the Contract Documents.
   2. Punch list items have been completed or corrected.
   3. Work is ready for final inspection.

B. Engineer will make an inspection to verify the status of completion with reasonable promptness.

C. Should the Engineer consider that the Work is incomplete or defective:
   1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective Work.
   2. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to the Engineer that the Work is complete.
   3. Engineer shall re-inspect the Work.

1.11 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to the Engineer at least 7 days prior to final Application for Payment.

B. Statement shall reflect all adjustments to the Contract amount.
   1. The original Contract amount.

2. Additions and deductions resulting from:
    a. Change Orders.
    b. Units installed and unit prices.
    c. Set-offs for uncorrected or incomplete Work.
    d. Set-offs for liquidated damages.
    e. Set-offs for reinspection payments.
    f. Extended engineering and/or inspection services and inspection overtime.
    g. Excessive Shop Drawings review cost by the Engineer.
    h. Other adjustments.
3. Total Contract amount, as adjusted.
4. Previous payments.
5. Remaining payment due.

C. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract amount which were not previously made by Change Orders.

1.12 FINAL APPLICATION FOR PAYMENT

A. Submit the final Application for Payment reflecting the agreed upon information provided in the final statement of accounting.

PART 2 PRODUCTS

2.01 SPARE PARTS

A. Deliver spare parts as specified in Section 01600 - Product Requirements.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01783

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 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.

1.07 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.

1.08 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 the 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 01850

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. 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures. (ASCE 7).

PART 2 PRODUCTS

2.01 DESIGN CRITERIA - SITE INFORMATION

A. Site name: South Valley Water Reclamation Facility.
   1. Street address: 7495 S 1300 W, West Jordan, UT 84084.
      a. Coordinates (approximate): Latitude 40.615612; Longitude -111.924623.
   2. Site elevation (approximate):
      a. 4304.4 feet above mean sea level.

2.02 DESIGN CRITERIA - REGULATORY REQUIREMENTS

A. Requirements of authorities having jurisdiction over the Project are included in Section 01410 - Regulatory Requirements.

2.03 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. 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.”

B. Delegated Design:
1. As specified in Section 01357 - Delegated Design Procedures.
2. Structural engineering design shall be performed by a Civil or Structural Engineer licensed in the State of Utah.

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 01410 - Regulatory Requirements, based on the Structure Risk Category indicated in Table: Project Structures - Risk Category and Seismic Design Information.

D. Seismic loads:
1. Seismic design parameters: Basic parameters - ASCE 7:
a. Ground motion MCE_R, 5 percent damped:
1) 0.2s Period Spectral Acceleration, Ss = 1.5 g.
2) 1s Period Spectral Acceleration, S_1 = 0.5 g.
b. Design Parameters:
1) 0.2s Period Design Spectral Acceleration, SDS = 1.01
2) 1s Period Spectral Acceleration, SD1 = 0.73
c. Mapped long-period transition period:
1) TL = 8 seconds.
2. Structures - General:
a. Seismic Design Category (SDC): As indicated in the following Table: Project Structures - Risk Category and Seismic Design Information.

Area	Description	Risk Category	Site Class	Seismic Design Category[(1)]
1	Headworks	III	D	D
4	Chemical Building	III	D	D
6	Utility Water Pump Station	III	D	D
10	Solids Processing Building	III	D	D
14	RAS/WAS Building 1	III	D	D
17	RAS/WAS Building 2	III	D	D

b. Structure response modification coefficient, R:
1) In accordance with ASCE 7 and the requirements of the Technical Sections.

3. 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 (ap), response factor (Rp), and overstrength factor for anchorage to concrete (Ωo):
        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 16 - Electrical.	1.5
All	Process Control and Instrumentation Systems: Components and distribution systems specified in Division 17 - Instrumentation and Controls.	1.5
All	Other equipment not listed above.	1.0

E. 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.

F. 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 01410 - 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.

3.02 DELEGATED DESIGN

A. Where Delegated Design is required by the Technical Sections, prepare and submit designs as specified in Section 01357 - 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 stamped by a Professional Engineer registered in the State of Utah 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.
      2) Existing concrete masonry in place prior to this Work: f'm = 1,500.

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

SECTION 03055

ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS IN CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Bonding reinforcing bars and all thread rods in concrete using adhesives.

1.02 REFERENCES

A. American Concrete Institute (ACI).
   1. 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

B. American National Standards Institute (ANSI):
   1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.

C. ASTM international (ASTM):
   1. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

D. Concrete Reinforcing Steel Institute (CRSI).

E. ICC Evaluation Service, Inc. (ICC-ES):
   1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

F. Society for Protective Coatings (SSPC):
   1. SP 1 - Solvent Cleaning.

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. Evaluation Service Report (ESR): Report prepared by ICC-ES or other testing agency acceptable to the Engineer and to the building official that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES acceptance criteria, and to document its acceptance for use under the building code specified in Section 01410 - Regulatory Requirements.

1.04 SUBMITTALS

A. Product data: Technical data for adhesives, including:
   1. Manufacturer’s printed installation instructions (MPII).

2. Independent laboratory test results indicating allowable loads in tension and shear for concrete of the types included in this Work, with load modification factors for temperature, spacing, edge distance, and other installation variables.
3. Handling and storage instructions.

B. Quality Control Submittals:
1. Special inspection: Detailed step-by-step instructions for the special inspection procedures required by the building code specified in Section 01410 - Regulatory Requirements.
2. For each adhesive to be used, Evaluation Report confirming that the product complies with the requirements of ICC-ES AC308 for both un-cracked and cracked concrete and for use in Seismic Design Categories A through F.
3. Installer qualifications:
   a. Submit evidence of successful completion of the adhesive manufacturer's installation training program.
   b. Submit evidence of current certification for installation of inclined and overhead anchors under sustained tension loading.
4. Inspection and testing reports:
   a. Field quality control: Reports of inspections and tests.
   b. Field quality assurance: Reports of special inspections and tests.

1.05 QUALITY ASSURANCE

A. Qualifications:
1. Installation requirements:
   a. Have available at the Site and install anchors in accordance with the adhesive MPII.
2. Installer qualifications:
   a. Demonstrating successful completion of the adhesive manufacturer's on-site training program for installation of adhesive-bonded anchors.
   b. Holding current certification for installation of adhesive-bonded anchors by a qualified organization acceptable to the Engineer and to the building official.
      1) Organizations/certification programs deemed to be qualified are:
         a) ACI-CRSI Adhesive Anchor Installer Certification Program.
         b) Adhesive anchor manufacturer's certification program, subject to acceptance by the Engineer and the building official.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 01600 - Product Requirements.

B. Store and protect products as follows, unless more restrictive requirements are recommended by the manufacturer:
1. Store adhesives and adhesive components on pallets or shelving in a covered-storage area protected from weather.
2. Control temperature to maintain storage within the manufacturer's recommended temperature range.
   a. If products have been stored at temperatures outside the manufacturer's recommended range, test by methods acceptable to the Engineer to confirm acceptability before installing in the Work.

3. Dispose of products that have passed their expiration date.

1.07 PROJECT CONDITIONS

A. As specified in Section 01850 - Design Criteria.

B. Seismic Design Category (SDC) for structures: As specified in Section 01850 - Design Criteria.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

B. Adhesives shall have a current Evaluation Report documenting testing and compliance in accordance with ACI 355.4 and ICC-ES AC308 for use with un-cracked concrete and with cracked concrete in the seismic design category specified.

C. Bond reinforcing bars and all thread rods in concrete using epoxy adhesive unless other adhesives specified are specifically indicated on the Drawings or approved in writing by the Engineer.

2.02 EPOXY ADHESIVE

A. Materials:
   1. In accordance with the physical requirements of ASTM C881, Type IV, Grade 3, Class B or C, depending on Site conditions.
   2. Two-component, 100 percent solids, insensitive to moisture.
   3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

B. Packaging:
   1. Disposable, self-contained cartridge system furnished in side-by-side cartridges designed to fit into a manually or pneumatically operated caulking gun, and with resin and hardener components isolated until mixing through the manufacturer's static mixing nozzle.
      a. Nozzle designed to dispense components in the proper ratio and to thoroughly blend the components for injection from the nozzle directly into the prepared hole.
      b. Provide nozzle extensions as required to allow full-depth insertion and filing from the bottom of the hole.
   2. Container markings: Include the manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

C. Manufacturers: One of the following or equal:
   1. Hilti, Inc., HIT-RE 500-V3.
   2. Simpson Strong-Tie Co., Inc., SET-3G.

2.03 ACRYLIC AND HYBRID ADHESIVE

A. Materials:
   1. Two-component, high-solids, acrylic-based or hybrid acrylic and epoxy-based adhesive.
   2. Approved by the manufacturer for installation at substrate temperatures of 0 degrees Fahrenheit and above.

B. Packaging:
   1. Disposable, self-contained cartridge system furnished in side-by-side cartridges designed to fit into a manually or pneumatically operated caulking gun, and with resin and hardener components isolated until mixing through the manufacturer's static mixing nozzle.
      a. Nozzle designed to dispense components in the proper ratio and to thoroughly blend the components for injection from the nozzle directly into prepared hole.
   2. Container markings: Include the manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

C. Manufacturers: One of the following or equal:
   1. Hilti, Inc., HIT-HY-200.
   2. Simpson Strong-Tie Co., Inc., AT-3G.

2.04 ALL THREAD RODS

A. Materials: As specified in Section 05120 - Structural Steel Framing for rods, nuts, and washers.

PART 3 EXECUTION

3.01 GENERAL

A. Execution of this Work is restricted to installers who have personally completed the adhesive manufacturer's on-site training for the products to be installed, and who are personally certified through a qualified certification program described under the Quality Assurance article and accepted by the Engineer and the building official.
   1. Do not install holes or adhesive until training is complete.

B. Perform Work in compliance with the accepted MPII and the following instructions. Where the accepted MPII and the instructions conflict, the MPII shall prevail.

C. Install reinforcing bars and all thread rods to embedment depth and at spacing and locations indicated on the Drawings.
   1. If embedment depth is not indicated, contact the Engineer for requirements.

3.02 PREPARATION

A. Do not begin installation of adhesive bonded anchors until:
   1. Concrete has achieved an age of at least 21 days after placement.

2. On-site training in installation of adhesive bonded anchors by the manufacturer's technical representative is complete. Do not drill holes in concrete or install adhesive and embeds in holes.

B. Review the MPII and "Conditions of Use" stipulated in the Evaluation Report before beginning work.
   1. Bring to the attention of the adhesive manufacturer's technical representative any discrepancies between these documents and resolve before proceeding with installation.

C. Install adhesive bonded anchors in full compliance with the MPII using personnel who have successfully completed the manufacturer's on-site training for products to be used and who hold certifications specified in this Section.

D. Confirm that adhesive and substrate receiving adhesive are within the manufacturer's recommended range for temperature and moisture conditions and will remain so during the curing time for the product.

3.03 HOLE SIZING AND INSTALLATION

A. Drilling holes:
   1. Determine location of reinforcing bars or other obstructions with a nondestructive indicator device and mark locations with construction crayon on the surface of the concrete.
   2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without prior acceptance by the Engineer.

B. Hole-drilling equipment:
   1. Electric or pneumatic rotary impact type with medium or light impact.
      a. Installation of anchors in cored holes is not permitted.
      b. Set drill to "rotation only" mode, or to "rotation plus hammer" mode in accordance with the manufacturer's installation instructions and the requirements of the Evaluation Report.
      c. Where edge distances are less than 2 inches and "rotation plus hammer" mode is permitted, use lighter impact equipment to prevent micro-cracking and concrete spalling during the drilling process.
   2. Drill bits: Carbide-tipped in accordance with ANSI B212-15, unless otherwise recommended by the manufacturer or required as a condition of use in the Evaluation Report.
      a. Hollow drill bits with flushing air systems are preferred. Air supplied to drill bits shall be free of oil, water, or other contaminants that will reduce bond.

C. Hole diameter: As recommended in the manufacturer's installation instructions and the Evaluation Report.

D. Hole depth: As recommended in the manufacturer's installation instructions to provide minimum effective embedment indicated on the Drawings.

E. Obstructions in drill path:
   1. If an existing reinforcing bar or other obstruction is hit while drilling a hole, unless otherwise accepted by the Engineer, stop drilling. Prepare and fill the

hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill another hole to the required depth.
    a. Obtain the Engineer's acceptance of distance between abandoned and relocated holes before proceeding with the relocation.
    b. Allow dry-pack mortar to cure to a strength equal to that of the surrounding concrete before resuming drilling in the area.
    c. Epoxy grout may be substituted for dry-pack mortar when accepted by the Engineer.
2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the member and endanger the stability of the structure.
3. When existing reinforcing steel is encountered during drilling and when specifically accepted by the Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter using pneumatic rotary impact drill.
4. Bent bar reinforcing bars: Where edge distances are critical and interference with existing reinforcing steel is likely, if acceptable to the Engineer, drill hole at 10-degree (or less) angle from axis of reinforcing bar or all thread rod being installed.

F. Cleaning holes:
1. Insert air nozzle to bottom of hole and blow out loose dust.
    a. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
    b. Provide minimum air pressure of 90 pounds per square inch for not less than 4 seconds.
2. Using a stiff bristle brush with diameter that provides contact around the full perimeter of the hole, vigorously brush hole to dislodge compacted drilling dust.
    a. Insert brush to the bottom of the hole and withdraw using a simultaneous twisting motion.
    b. Repeat at least 4 times.
3. Repeat the preceding steps as required to remove drilling dust or other material that will reduce bond, and in the number of cycles required by the MPII and the Evaluation Report.
4. Leave prepared holes clean and dry.
5. Protect prepared and cleaned holes from contamination and moisture until adhesive is installed.
6. Re-clean and dry previously prepared holes if, in the opinion of the Engineer, the hole has become contaminated after initial cleaning.

3.04 INSTALLATION OF ADHESIVE AND INSERTS

A. Clean and prepare inserts reinforcing bars and all thread rods:
1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. Inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
2. Solvent clean prepared reinforcing bars and all thread rods over the embedment length in accordance with SSPC-SP 1. Provide an oil- and grease-free surface for bonding of adhesive to steel.

B. Fill holes with adhesive:
   1. Use epoxy adhesive anchors unless acrylic and hybrid adhesive anchors have been approved for use for the specific location and conditions by the Engineer.
   2. Fill hole with adhesive only when dry. Do not fill when the hole is filled with water or damp, except with written authorization by the Engineer.
   3. Starting at the bottom of the hole, fill hole with adhesive inserting the reinforcing bar or all thread rod.
   4. Fill hole as nozzle is withdrawn without creating air voids.
   5. Unless otherwise indicated on the Drawings, fill hole with sufficient adhesive so that excess adhesive is extruded out of the hole when the reinforcing bar or all thread rod is inserted.
   6. Where necessary, seal hole at surface of concrete to prevent loss of adhesive during curing.

C. Installing reinforcing bars and all thread rods.
   1. Unless otherwise indicated on the Drawings, install bars and rods perpendicular to the concrete surface.
   2. Insert reinforcing bars and all thread rods into adhesive in accordance with the manufacturer's recommended procedures.
   3. Confirm that insert has reached the designated embedment in the concrete and that adhesive completely surrounds the embedded portion.
   4. Securely brace bars and all thread rods in place to prevent displacement while the adhesive cures. Bars and rods displaced during curing will be considered damaged and replacement will be required.
   5. Clean excess adhesive from the mouth of the hole.

D. Curing and loading.
   1. Provide and maintain curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the temperature of the concrete.
   2. Do not disturb or load bonded embeds until the manufacturer's recommended cure time, based on temperature of the concrete, has elapsed.

3.05 POST-INSTALLATION ACTIVITIES

A. Do not bend bars or all thread rods after bonding to the concrete, unless accepted in advance by the Engineer.

B. Attachments to all thread rods:
   1. After assemblies to be connected are placed, install nuts and washers for threaded rods as indicated on the Drawings.

3.06 FIELD QUALITY CONTROL

A. Provide field quality control over the Work of this Section as specified in Section 01450 - Quality Control.

B. Do not allow Work described in this Section to be performed by individuals who do not hold the specified certifications and who have not completed the specified jobsite training.

C. Manufacturer's services:
   1. Before beginning installation, adhesive manufacturer's technical representative to conduct on-site training in proper storage and handling of adhesive, drilling and cleaning of holes, and preparation and installation of reinforcing bars and all thread rods.
      a. Provide notice of scheduled training to the Engineer and to special inspector(s) not less than 10 working days before training occurs. Engineer and special inspector may attend training sessions.
   2. Submit record, signed by the manufacturer's technical representative, listing the Contractor's personnel who completed the training. Only qualified personnel who have completed the manufacturer's on-site training shall perform installations.

D. Field inspections and testing:
   1. Hole drilling and preparation.
   2. Results: Submit records of inspections and testing to the Engineer by electronic copies within 24 hours after completion.

3.07 FIELD QUALITY ASSURANCE

A. Provide field quality assurance over the Work of this Section as specified in Section 01450 - Quality Control.

B. Special inspections, special tests, and structural observation:
   1. Provide as specified in Section 01455 - Regulatory Quality Assurance.
   2. Frequency of inspections:
      a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Evaluation Report for the product installed.
      b. Provide continuous inspection for the initial installation of each type and size of adhesive bonded reinforcing bar and all thread rod. Subsequent installations of the same anchor may be installed with periodic inspection as defined in subsequent paragraphs.
      c. Provide continuous inspection of drilling, cleaning and bonding activities for bars and rods installed in horizontal and upwardly inclined positions.
   3. Preparation:
      a. Review Drawings and Specifications for the Work to be observed.
      b. Review the adhesive manufacturer's MPII and recommended installation procedures.
      c. Review Evaluation Report "Conditions of Use" and "Special Inspection" requirements.
   4. Inspection: Periodic:
      a. Initial inspection. Provide an initial inspection for each combination of concrete and reinforcing bar strength or concrete strength and all thread rod material being installed. During initial inspection, observe the following for compliance with the installation requirements.
         1) Concrete: Class (minimum specified compressive strength) and thickness.
         2) Environment: Temperature conditions at the work area and moisture conditions of concrete and drilled hole.

3) Holes: Locations, spacing, and edge distances; verification of drill bit compliance with requirements; cleaning equipment and procedures; cleanliness of hole. Before adhesive is placed, confirm that depth and preparation of holes conforms to the requirements of the Contract Documents, the MPII, and the “Conditions of Use” listed in the Evaluation Report.
4) Adhesive: Product manufacturer and name, lot number and expiration date, temperature of product at installation, installation procedure. Note initial set times observed during installation.
5) Reinforcing bars and all thread rods: Material diameter and length; steel grade and/or strength; cleaning and preparation; cleanliness at insertion; minimum effective embedment provided.

b. Subsequent inspections: Subsequent installations of the same reinforcing bars or all thread rods may be performed without the presence of the special inspector, provided that:
1) There is no change in personnel performing the installation, the general strength and characteristics of the concrete receiving the inserts, or the reinforcing bars and all thread rods being used.
2) For ongoing installations, the special inspector visits the Site at least once per day during each day of installation to observe the Work for compliance with material requirements and installation procedures.

5. Inspection: Continuous.
a. Make observations as described under “Inspection - Periodic, Initial Inspection” during drilling, cleaning, and bonding activities for all bars and rods installed.

6. Records of inspections:
a. Provide a written record of each inspection using forms acceptable to the Engineer and to the building official.
b. Submit electronic copies of inspection reports to the Engineer within 24 hours after completion of inspection.

END OF SECTION

SECTION 03600

GROUTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Preblended grout:
      a. Non-shrink cement grout.
         1) General use.
      b. Non-shrink epoxy grout.
         1) General use.

1.02 REFERENCES

A. American Concrete Institute (ACI).

B. ASTM International (ASTM):
   1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch cube specimens).
   2. C144 - Standard Specification for Aggregate for Masonry Mortar.
   3. C150 - Standard Specification for Portland Cement.
   4. C404 - Standard Specification for Aggregates for Masonry Grout.
   5. C531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   6. C579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.
   7. C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.
   8. C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   9. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
   10. C1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.
   11. C1437 - Standard Test Method for Flow of Hydraulic Cement Mortar.

C. International Concrete Repair Institute (ICRI):
   1. 310.2R - Selecting and specifying Concrete Surface Preparations for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

D. Society for Protective Coatings (SSPC):
   1. SP 1 - Solvent Cleaning.

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. Grout consistency. From most flowable to least flowable:
      a. Fluid:
         1) Forms a nearly level surface without vibration or rodding.
         2) Efflux time is between 10 and 30 seconds when tested by the flow cone method in accordance with ASTM C939.
      b. Flowable:
         1) Forms a nearly level surface when lightly rodded.
         2) Efflux time is greater than 30 seconds when tested by the flow cone method in accordance with ASTM C939.
         3) Flow is 125 to 145 percent when tested by the flow table method in accordance with ASTM C1437, modified in accordance with applicable provisions of ASTM C1107 (5 drops of flow table in 3 seconds).
      c. Plastic:
         1) Flow is 100 to 125 percent when tested by the flow table method in accordance with ASTM C1437, modified in accordance with applicable provisions of ASTM C1107 (5 drops of flow table in 3 seconds).
      d. Stiff plastic:
         1) Flow is 50 to 99 percent when tested by the flow table method in accordance with ASTM C1437, modified in accordance with applicable provisions of ASTM C1107 for plastic mixes.
      e. Dry pack:
         1) Grout that can be molded in closed fist without showing water when squeezed, and without crumbling when pressure is released.
         2) Flow is 0, or near 0 percent, when tested by the flow table method in accordance with ASTM C1437, modified in accordance with applicable provisions of ASTM C1107 for plastic mixes.
   2. Preblended grout: Grout with constituent materials proportioned, thoroughly blended, and packaged by a manufacturer for the addition of water (cement-based grout) or catalysts (epoxy-based grout) at the construction site.

1.04 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Preblended grouts:
      a. Manufacturer’s instructions for preparation of surface receiving grout.
      b. Manufacturer’s instruction for mixing, placement, and curing of grout.

1.05 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 01600 - Product Requirements and the manufacturer’s instructions.

1.06 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.07 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01600 - Product Requirements.

B. Locations of use:
   1. See Schedules at the end of Part 3 of this Section.

2.02 PREBLENDED GROUT

A. Non-shrink cement grout:
   1. General requirements:
      a. Hydraulic-cement based, pre-proportioned, pre-blended, and pre-packaged mix, requiring only the addition of water.
      b. In accordance with ASTM C1107.
      c. Non-metallic: Containing no metallic particles, such as aluminum powder, and no metallic aggregate, such as iron filings.
      d. Allowing for the addition of non-reactive mineral aggregate when recommended by the manufacturer for placements with increased thermal mass due to depth or volume.
      e. Consistency:
         1) Manufacturer’s mixing instructions allow for mixing to consistencies required for placement.
            a) Fluid, flowable, or plastic, as defined in ASTM C1107.
            b) Stiff plastic or dry pack as specified in this Section.
      f. Temperatures:
         1) Installation and curing: Manufacturer’s recommendations allow mixing, placing, and curing at temperatures ranging from 45 to 90 degrees Fahrenheit.
         2) Service: After 28 days curing, suitable for exposure to temperatures of at least 400 degrees Fahrenheit.
      g. Working time:
         1) Provides designated consistency for at least 20 minutes after mixing at the temperature where grout will be installed.
      h. Dimensional stability:
         1) Height change: Positive expansion in accordance with the requirements of ASTM C1107 for early height change, and for height change during moist curing.

2. Non-shrink cement grout - General use (NSCG):
    a. Additional requirements:
        1) Compressive strength: In accordance with the following when tested in accordance with ASTM C109, as modified in ASTM C1107:

NSCG: Minimum Compressive Strength (psi)	
	Fluid
1 day	3,500
3 days	4,400
7 days	6,500
28 days	7,500

    b. Manufacturers: One of the following or equal:
        1) Dayton Superior, 1107 Advantage Grout.
        2) Euclid Chemical Co., NC Grout.
        3) Five Star Products, Inc., Five Star Grout.
        4) L&M Construction Chemicals, Inc., Duragrout.
        5) Sika Corporation, SikaGrout 713
        6) Sika Corporation, SikaGrout 212.
        7) US Spec, GP Grout.

B. Non-shrink epoxy grout:
    1. General requirements:
        a. System consisting of epoxy resin and hardener plus aggregate.
            1) Epoxy: 100 percent solids, 2-component thermosetting resin and hardener.
            2) Aggregate: Non-reactive mineral material provided by the manufacturer.
        b. Pre-proportioned and pre-packaged for mixing.
        c. Non-metallic: Containing no metallic aggregate such as aluminum or iron filings.
        d. Allowing for the addition of mineral aggregate when recommended by the manufacturer for placements with increased thermal mass due to depth or volume.
        e. Consistency: Flowable as required for the conditions of placement.
        f. Working time: Retains consistency for placement for at least 15 minutes after mixing at the temperature where the grout will be installed.
        g. Temperature:
            1) Installation and curing: Manufacturer’s recommendations allow mixing, placing, and curing at temperatures ranging from 45 to 90 degrees Fahrenheit.
            2) Service temperature: Cured material suitable for exposure to temperatures up to 140 degrees Fahrenheit.

h. Consistency and working time:
    1) Flowable for at least 10 minutes after mixing with catalyst when tested at 60 degrees Fahrenheit.
i. Dimensional stability:
    1) Shrinkage or expansion: In accordance with at least one of the following:
        a) Shrinkage: Less than 0.0006 inches per inch when tested in accordance with ASTM C531.
        b) Expansion: Positive expansion when tested in accordance with ASTM C827.
    2) Compressive creep: In accordance with at least one of the following:
        a) Not exceeding 0.004 inches per inch when tested in accordance with ASTM C1181 under constant load of 600 pounds per square inch at 140 degrees Fahrenheit.
        b) Not exceeding 0.002 inches per inch when tested in accordance with ASTM C1181 under constant load of 400 pounds per square inch at 140 degrees Fahrenheit.
    3) Coefficient of thermal expansion:
        a) Not exceeding 0.000019 inches per inch per degree Fahrenheit when tested in accordance with ASTM C531, Method B.

2. Non-shrink epoxy grout - General use (NSEG):
    a. Additional requirements:
        1) Compressive strength: Minimum when tested in accordance with ASTM C579, Method B.

NSEG: Minimum Compressive Strength (psi)	
	Fluid
1 day	9,000
7 days	11,500

    b. Manufacturers: One of the following or equal:
        1) Dayton Superior, J55/Pro-Poxy 2000.
        2) Euclid Chemical Co., E3-Flowable Grout.
        3) Five Star Products, Inc., Five Star DP Epoxy Grout.
        4) Laticrete/L&M Construction Chemicals, Inc., Epogrout 758.
        5) Sika Corporation, SikaFlow 648.
        6) Sika Corporation, Sikadur-42 Grout-Pak.
        7) US Spec, EPG 2000.

PART 3 EXECUTION

3.01 PREPARATION

A. General:
   1. Protect surfaces adjacent to grouting operations. Prevent grout staining.
   2. Preblended grout:
      a. Refer to the manufacturers' product literature for limits on physical or environmental conditions associated with storage and use of products.
      b. Review any special conditions with manufacturers, prior to installation of products. Document discussions and submit records to the Engineer.

B. Surface preparation:
   1. General:
      a. Remove grease, oil, dirt, dust, ice, and frost, curing compounds, laitance, paint, and other deleterious materials that reduce grout bond to substrate.
   2. Concrete surfaces receiving grout:
      a. Roughen surface in accordance with the grout manufacturer's recommendations.
         1) Take care during surface preparation to avoid microcracking of the base materials.
         2) Roughen concrete surfaces in contact with grout to surface profile CSP-6 in accordance with ICRI 310.2R.
         3) Remove loose or broken concrete.
   3. Concrete surfaces receiving cement-based grouts:
      a. Saturate concrete surface receiving the grout, and adjacent concrete surfaces 6 inches beyond limits of grout, with clean water or not less than 24 hours before grout placement.
      b. Immediately prior to grout placement, remove standing water from concrete and anchor holes. Use clean rags or oil-free compressed air to leave saturated surface-dry (SSD) condition.
   4. Concrete surfaces receiving epoxy-based grouts:
      a. Do not wet surfaces with water. Provide dry surface with moisture content not exceeding the grout manufacturer's recommended limits.
      b. Prepare surfaces as recommended by the grout manufacturer.
      c. Before placing epoxy-based grouts, wet surfaces with epoxy:
         1) Horizontal work: Wet with epoxy used for epoxy grout.
         2) Vertical and overhead work: Wet with epoxy gel compatible with epoxy used in epoxy grout.

C. Base plates:
   1. For large or complex base plates, including base plates with shear lugs:
      a. Provide plates with air relief holes at least 1/8 inch in diameter and spaced to prevent entrapment of air for complete filling under the plate.
   2. Remove grease, oil, dirt, dust, ice and frost, debris, and other materials that would contaminate grout or result in uneven bearing below plates.
      a. Clean anchor holes and block-outs.
      b. Clean surfaces in accordance with SSPC-SP 1.

3. Base plates over non-shrink epoxy grout:
    a. At locations where equipment will be removed for maintenance or replacement, coat base plate with 2 coats of heavy duty paste wax to prevent bonding to grout.

D. Forms for grout:
    1. Construct forms:
        a. With adequate strength and stiffness to withstand grout placement and consolidation procedures without deformation.
        b. That provide a smooth and uniform finish for grout surfaces.
        c. That are liquid tight. Caulk cracks and joints with elastomeric sealant compatible with the trout to be placed.
        d. That allow venting of displaced air.
        e. That allow grout to flow horizontally beyond the perimeter of the base plate a distance not less than the thickness of the grout or 1 inch.
        f. Line forms with polyethylene, or coat with 2 coats of heavy paste wax, to allow for easy form release.
    2. Construct forms with head box.
        a. Make head box continuous over entire length of one side of form.
            1) For larger placements, space head boxes to maintain continuous flow of grout from one side of the base plate to the other.
        b. Make head box height sufficient to force grout to flow under full dimensions of base and to the surrounding form faces.
        c. Position bottom of head box not less than 4 to 6 inches higher than bottom of the base plate.

3.02 INSTALLATION

A. General:
    1. Maintain temperature of grouts, their constituent materials, and surfaces receiving the grouts within the manufacturer's specified limits during grout mixing, placement, and curing.

B. Mixing:
    1. General:
        a. Mix grouts to uniform consistency and to provide uniform distribution of constituent materials throughout the mix before beginning placement.
        b. Where grout includes aggregate, mix until aggregate is uniformly wetted and dispersed in the mix.
        c. Avoid overworking and entrapment of air in the mix.
    2. Preblended grout:
        a. Mix products in accordance with the manufacturer's instructions.
            1) Comply with the manufacturer's recommendations for conditioning of materials prior to mixing.
            2) Mix in complete units. Do not mix partial batches.
            3) Do not vary ratio of components from the manufacturer's instructions.
        b. Non-shrink cement grout:
            1) Pre-measure water for mixing. Do not exceed the manufacturer's recommended water content for the mix consistency to be used.
            2) Do not re-temper by adding water as the mix stiffens.

c. Non-shrink epoxy grout:
    1) Manufacturer's reported working time may vary significantly from working time for actual on-site conditions.
    2) Make preparations to mix, place, and consolidate grout rapidly and within actual on-site working time.
    3) Do not add solvents to adjust consistency.

C. Placement:
1. General:
    a. Place grout:
        1) Only after location, leveling, and alignment of structural elements and equipment is within required tolerances.
        2) Only after verifying compliance of grout substrates and environmental conditions.
        3) Immediately after mixing, and in a continuous placement.
    b. Flowable grout:
        1) Fill head boxes and work grout down so it flows under base plate.
        2) At all times, keep the level of grout in the head box above the bearing surface of the base plate, sole plate, or skid.
        3) Maintain hydraulic pressure and continuous flow of grout from head box to opposite side of forms without trapping air or forming voids.
        4) Completely fill grout space, placing grout only to the bottom edge of bearing or base plates.
        5) Vibrate, rod, or chain flowable and plastic grout to facilitate grout flow, consolidate grout, and remove trapped air.
    c. Dry pack grout:
        1) Pack into confined space, without voids, using tamping or ramming procedures recommended by the grout manufacturer.
2. Preblended grout:
    a. General:
        1) Place grout within the manufacturer's recommended working time for the temperature conditions during installation.
    b. Non-shrink cement grout:
        1) After grout reaches initial set, remove forms and trim vertical edges of grout at a 45-degree angle sloping out and down from bottom edge of base plate to top of support.
        2) Finish cut surface to uniform texture.
    c. Non-shrink epoxy grout:
        1) Do not trim edges of grout after it sets. Construct forms using chamfered edges built into the formwork to create sloped edge at perimeter.

D. Curing:
1. Cement based grouts:
    a. Keep continuously wet for minimum of 7 days after initial set.
        1) Use wet burlap, soaker hose, sun shading, ponding, or a combination of these methods.

b. Temperature: Maintain temperature of grout, substrate, and elements:
    1) Cold weather:
        a) Above 70 degrees Fahrenheit for a minimum of 24 hours after placement to avoid damage from freezing.
        b) Above 40 degrees Fahrenheit until grout has attained compressive strength of 3,000 pounds per square inch, but not less than 7 days.
    2) Hot weather:
        a) Below 90 degrees Fahrenheit for a minimum of 72 hours after placement.

2. Epoxy-based grouts:
    a. Cure grouts in accordance with the manufacturers' recommendations.
    b. Temperature: Maintain temperature of grout, substrate, and elements:
        1) Cold weather:
            a) Above 70 degrees Fahrenheit for a minimum of 48 hours after placement.
        2) Hot weather:
            a) Below 80 degrees Fahrenheit for a minimum of 24 hours after placement.

3.03 FIELD QUALITY CONTROL

A. Provide field quality control over the Work of this Section as specified in Section 01450 - Quality Control.

B. Field quality control by the Contractor:
    1. Inspections: Observe grout mixing and placement to confirm:
        a. Product or mix installed at each location.
        b. Preblended grouts:
            1) Mixing of full volume of prepackaged materials.
            2) Mixed and placed within the manufacturer's recommended temperature and working time limits.
            3) Cement-based: Addition of water complies with the manufacturer's instructions for specified strength and required consistency.
        c. Complete and uniform filling of spaces designed for grouting.
        d. Curing and protection as specified.
    2. Field testing - Preblended grout:
        a. Not required.

C. Field quality control by the Owner:
    1. Special inspections:
        a. Observe structure bearing plates and equipment base plates for presence of grout and for complete filling of grout spaces.

3.04 CLEANING

A. Remove grout from adjacent surfaces.

3.05 SCHEDULES

A. Install grout at locations indicated on the Drawings.

B. General applications for products specified in this Section are specified in the General Applications for Grout Materials table below.
   1. Where specified grout or repair materials are not indicated on the Drawings or in the other Sections of the Specifications, confirm requirements with the Engineer before installation.

General Applications for Grout Materials	
Product	**Application**
Preblended Grouts	
Non-shrink cement grout	General use (NSCG): • Below base plates and bearing plates for structural framing. • Below equipment bases, sole plates and skids unless otherwise indicated on the Drawings. • Locations indicated on the Drawings.
Non-shrink epoxy grout	General use (NSEG): • Locations indicated on the Drawings.

END OF SECTION

SECTION 04055

ADHESIVE BONDING REINFORCING BARS AND ALL THREAD RODS IN MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Bonding reinforcing bars and all thread rods in masonry using injectable, 2-component adhesive.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. B212.15 - Cutting Tools - Carbide-Tipped Masonry Drills and Blanks for Carbide-Tipped Masonry Drills.

B. ICC Evaluation Service, Inc. (ICC-ES):
   1. AC58 - Acceptance Criteria for Adhesive Anchors in Masonry Elements.

C. Society for Protective Coatings (SSPC):
   1. Surface Preparation Standards (SP).
      a. SP-1 - Solvent Cleaning.

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. Evaluation Report: Prepared by ICC-ES, or by other testing agency acceptable to the Engineer and to the Authority Having Jurisdiction, that documents testing and review of the adhesive product to confirm that it conforms to the requirements of ICC-ES AC58.

1.04 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures and Section 01600 - Product Requirements.

B. Product data: Furnish technical data for adhesives, including:
   1. Independent testing laboratory results indicating allowable loads in tension and shear for masonry walls of the types included in the Work, with load modification factors for temperature, spacing, edge distance, and other installation variables.
   2. Handling and storage instructions.
   3. Installation instructions.

C. Quality Control Submittals:
   1. Special inspection: Detailed instructions for special inspection to comply with the building code specified in Section 01410 - Regulatory Requirements and as required by the Evaluation Report for each product.

2. Evaluation Report confirming that the product complies with the requirements of ICC-ES AC58.

1.05 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 01600 - Product Requirements and the manufacturer's instructions.

B. Store and protect as follows, unless the manufacturer has more stringent requirements:
   1. Store adhesive components on pallets or shelving in a covered-storage area protected from weather.
   2. Control temperature to maintain storage within the manufacturer's recommended temperature range.
      a. If products are stored at temperatures outside the manufacturer's recommended range, test components prior to use by methods acceptable to the Engineer to determine if the products still meet specified requirements.
   3. Dispose of products that have passed their expiration date.

1.06 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

B. Seismic design category (SDC) for structures: As specified in Section 01850 - Design Criteria.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials: Use end products of one manufacturer to achieve structural compatibility and single-source responsibility.

2.02 ADHESIVE FOR SELF-CONTAINED CARTRIDGE SYSTEM

A. Shall have a current Evaluation Report demonstrating compliance with the requirements of ICC-ES AC58.

B. Materials:
   1. 2-component structural adhesive, insensitive to moisture, and gray in color.
   2. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

C. Packaging:
   1. Furnished in disposable, side-by-side cartridges with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle.
      a. Nozzle designed to thoroughly blend the components, in the proper mixing ratio, for injection from the nozzle directly into prepared hole.
      b. Provide nozzle extensions as required to allow full-depth insertion and filling from the bottom of the hole.
   2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

D. For installation in solid masonry and solid-grouted masonry (concrete or brick):
   1. Manufacturers: One of the following or equal:
      a. Hilti, Inc., HY-270 Adhesive Anchor System.
      b. Simpson Strong-Tie Co., Inc., ET-HP Anchoring Adhesive.
      c. USP Structural Connectors, CIA-GEL 7000 Masonry Epoxy Adhesive.

E. For installation in un-grouted and partially-grouted masonry (concrete or brick) and in masonry containing voids or holes (concrete or brick):
   1. Manufacturers: The following or equal:
      a. Hilti, Inc., HY-270 Adhesive Anchor System.
         1) Provide manufacturer's plastic mesh sleeve for bonding reinforcing bar(s) or all thread rod(s) of the size and embedment indicated on the Drawings.

2.03 ALL THREAD RODS

A. As specified in Section 05120 - Structural Steel Framing.

2.04 REPAIR MATERIALS

A. Dry-pack mortar: As specified in Section 03366 - Concrete Finishes.

B. Epoxy grout: As specified in Section 03600 - Grouting.

PART 3 EXECUTION

3.01 GENERAL

A. Unless otherwise required for "Conditions of Use" in the Evaluation Report submitted, prepare and install holes, adhesive, and inserts (all thread rods or reinforcing bars) in accordance with the manufacturer's recommendations and this Section.
   1. In the event of conflicts, the more restrictive provisions shall govern.

B. Do not install adhesive-bonded all thread rods or reinforcing bars in upwardly inclined and overhead applications.

3.02 PREPARATION

A. Prior to completing the manufacturer's on-site training specified in this Section, do not:
   1. Drill holes for reinforcing bars or all thread rods.
   2. Mix or install adhesive in holes.

B. Review the manufacturer's installation instructions and "Conditions of Use" stipulated in the Evaluation Report before beginning Work.

C. Confirm that adhesive and substrate receiving adhesive are within the manufacturer's recommended temperature range and will remain so during the cure time for the product.

3.03 HOLE LAYOUT AND INSTALLATION

A. Drilling holes:
   1. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device. Mark locations with on the surface of the masonry using removable construction crayon, or other method acceptable to the Engineer.
   2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the masonry without prior acceptance by the Engineer.

B. Hole drilling equipment:
   1. Electric or pneumatic rotary impact type.
      a. Set drill to "rotation only" mode, or to "rotation plus hammer" mode in accordance with the manufacturer's installation instructions and the requirements of the Evaluation Report.
   2. Where edge distances are less than 2 inches and "rotation plus hammer" mode is permitted, use lighter impact equipment to prevent micro-cracking and spalling from drilling.
   3. Drill bits: Carbide-tipped in accordance with ANSI B212-15.
   4. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.

C. Hole diameter: As recommend in the manufacturer's installation instructions and the Evaluation Report.

D. Hole depth: As recommended by the manufacturer's installation instructions to provide minimum effective embedment indicated on the Drawings.

E. Obstructions in drill path:
   1. If an existing reinforcing bar or other obstruction is hit while drilling hole, stop drilling and fill the hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill to the required depth.
      a. Allow dry-pack mortar to cure to strength equal to that of the surrounding masonry before resuming drilling in that area.
      b. Epoxy grout may be substituted for dry-pack mortar when acceptable to the Engineer.

2. Avoid drilling an excessive number of adjacent holes that would weaken the structural member and endanger the stability of the structure. Obtain the Engineer's acceptance of distance between abandoned and relocated holes.

F. Cleaning holes:
   1. Insert air nozzle to bottom of hole and blow out loose dust.
      a. Use compressed air that is free of oil, water, or other contaminants.
      b. Provide minimum air pressure of 90 pounds per square inch for not less than 4 seconds.
   2. Using a stiff bristle brush of diameter that provides contact around the full perimeter of the hole, vigorously brush the hole to dislodge compacted drilling dust.
      a. Insert brush to the bottom of the hole and withdraw using a simultaneous twisting motion.
      b. Repeat at least 4 times.
   3. Repeat the preceding steps as required to remove drilling dust or other material that will reduce bond, and as required by the manufacturer and the Evaluation Report.
   4. Leave prepared hole clean and dry.

3.04 INSTALLATION OF ADHESIVE AND INSERTS

A. Clean and prepare inserts:
   1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. Inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
   2. Solvent-clean prepared reinforcing bars and all thread rods over their embedment length in accordance with SSPC SP-1. Provide an oil and grease-free surface for bonding of adhesive to steel.

B. Fill holes with adhesive:
   1. Solid or solid-grouted masonry:
      a. Only when dry. Do no fill with adhesive when the hole is filled with water or damp except with written authorization by the Engineer.
      b. Starting at the bottom of the hole: Before inserting the reinforcing bar or all thread rod.
      c. Without creating air voids as nozzle is withdrawn.
      d. Fill with sufficient adhesive so that excess is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.
      e. Where metal or plastic screens are required for use in masonry (units with hollow cells or holes, and multi-wythe brick walls), fill screen with adhesive and insert into hole in accordance with the manufacturer's recommendations.
   2. Masonry with holes or un-grouted cells:
      a. Provide manufacturer's mesh screen tubes (steel or plastic mesh), fill with adhesive, and install in compliance with the manufacturer's instructions.

C. Install reinforcing bars and all thread rods:
   1. Install to depth, spacing, and locations as indicated on the Drawings.
   2. Insert into hole in accordance with the manufacturer's recommended procedures. Confirm that insert has reached the designated embedment in the hole and that adhesive completely surrounds the embedded portion.
   3. Clean excess adhesive from the mouth of the hole.

D. Curing and loading:
   1. Provide curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the actual temperature of the masonry.
   2. Do not disturb or load anchors until the manufacturer's recommended cure time has elapsed.

3.05 FIELD QUALITY CONTROL

A. As specified in Section 01450 - Quality Control.

B. Manufacturers' services:
   1. Before beginning installation, furnish adhesive manufacturer's representative to conduct on-site training in proper storage and handling of adhesive, drilling and cleaning of holes, and preparation and installation of reinforcing bars and all thread rods.
      a. Provide notice of training to the Engineer and special inspector not less than 10 working days before training occurs. Engineer and special inspector may attend training sessions.
   2. Submit record, signed by the Engineer, listing the Contractor's personnel who completed the training. Only qualified personnel who have completed the manufacturer's on-site training shall perform installations.
   3. Do not install holes or adhesive until training is complete.

3.06 FIELD QUALITY ASSURANCE

A. Special inspection:
   1. As specified in Section 01455 - Regulatory Quality Assurance.
   2. Unless otherwise indicated on the Drawings or in this Section, provide special inspection as required by the "Conditions of Use" in the Evaluation Report for the product installed.
   3. Provide a written record of each inspection using form acceptable to the Engineer and the Authority Having Jurisdiction.
   4. Preparation:
      a. Review Drawings and Specifications for the Work being observed.
      b. Review the adhesive manufacturer's recommended installation and evaluation report's special inspection procedures.
   5. Provide an initial inspection by for each combination of masonry type and reinforcing bar or all thread rod being installed.
      a. During initial inspection, observe the following for compliance with installation requirements. Furnish report of inspection that includes the following items:
         1) Masonry construction: Type and thickness; whether fully or partially grouted; locations and types of voids and holes in units.

2) Environment: Temperature and moisture conditions of masonry base material and work area.
3) Holes: Locations, spacing, edge distances; verification of drill bit compliance with ANSI B212.15; cleaning equipment and procedures; cleanliness of hole.
    a) Before placing adhesive, confirm that depth and preparation of holes conforms to requirements of the Contract Documents, installation recommendations of the manufacturer, and "Conditions of Use" specified in the Evaluation Report.
4) Adhesive: Product manufacturer and name; lot number and expiration date; temperature of product at installation; installation procedures. Note initial set times observed during installation.
5) Embedded reinforcing bars and all thread rods: Material diameter and length; steel grade and/or strength; cleaning and preparation; cleanliness at insertion; minimum effective embedment.

6. Subsequent installations of the same reinforcing bars or threaded rods in the same masonry may be performed without the presence of the special inspector, provided that:
    a. There is no change in the personnel performing the installation, the type or details of the masonry receiving the insert, the adhesive or the reinforcing bars and all thread rods being used. Changes in any of these items shall require a new initial inspection.
    b. For ongoing installations over a period of time, the special inspector visits the Site at least once per day during each day of installation to observe the Work for compliance with material requirements and installation procedures.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Structural steel shapes and plate.
   2. Fasteners and structural hardware:
      a. All thread rods.
      b. High-strength bolts.
   3. Welding.
   4. Bolting.

1.02 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. 303 - Code of Standard Practice for Steel Buildings and Bridges.
   2. 360 - Specification for Structural Steel Buildings.

B. American Iron and Steel Institute (AISI):
   1. Steel alloys (types) as indicated.

C. American Welding Society (AWS):
   1. A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   2. A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
   3. A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
   4. D1.1 - Structural Welding Code - Steel.

D. ASTM International (ASTM):
   1. A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
   2. A36 - Standard Specification for Carbon Structural Steel.
   3. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   4. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   6. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   7. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   8. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   9. A992 - Standard Specification for Structural Steel Shapes.
   10. F436 - Standard Specification for Hardened Steel Washers.

11. F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
12. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
13. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
14. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.

E. Research Council on Structural Connections (RCSC):
1. Specification for Structural Joints Using High-Strength Bolts (RCSC Specification).

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. Snugtight: At bolted joints, the tightness attained with a few impacts of an impact wrench, or by the full effort of an ironworker using a spud wrench to bring the connected plies into firm contact.

1.04 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures and Section 01600 - Product Requirements.

B. Product data:
Welding electrodes: Electrode manufacturer’s data.

C. Shop Drawings:
1. Fabrication and erection drawings.

D. Quality Control Submittals:
1. Welding procedure specifications (WPS) in accordance with AWS D1.1.
a. Submit WPS for each type of welded joint used, whether prequalified or qualified by testing.
1) State electrode manufacturer and specific electrodes used.
2) Indicate required AWS qualification for joint.
b. Submit WPS with Shop Drawings that indicate those welds.
c. Submit Procedure Qualification Record (PQR) in accordance with AWS for welding procedures qualified by testing.
2. Welder qualifications: For each welding process and position:
a. Welder’s qualification certificates.
b. Contractor’s statement that certificate will be “in effect” at the time(s) welding will be performed based on the “Period of Effectiveness” provisions of AWS D1.1.
3. Steel fabricator’s AISC certification.

E. Test reports:
   1. Certified copies of mill tests and analyses made in accordance with applicable ASTM standards, or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural steel or part thereof having common properties.

1.05 QUALITY ASSURANCE

A. Certification:
   1. Steel fabricators shall be certified by the AISC or other certification acceptable to the Engineer and the building official having jurisdiction.

B. Welding:
   1. Perform welding of structural metals in accordance with AWS D1.1 using welders who have current AWS qualification certificate for the process, position, and joint configuration to be welded.
   2. Make welding procedure specifications available at the locations where welding is performed.
   3. Notify the Engineer at least 24 hours before starting shop or field welding.
   4. Engineer may check materials, equipment, and qualifications of welders.
   5. Remove welders performing unsatisfactory Work, or require requalification.
   6. Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
   7. Contractor shall bear costs of retests on defective welds.
   8. Contractor shall also bear costs in connection with qualifying welders.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 01600 - Product Requirements.

B. Packing and shipping: Deliver structural steel free from mill scale, rust, and pitting.

C. Storage and protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.

PART 2 PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified or indicated on the Drawings, materials shall be in accordance with the following:

Item	ASTM Standard	Class, Grade, Type, or Alloy Number
Carbon Steel		
Plate, bars, rolled shapes (except W and WT shapes), and miscellaneous items	A36	--
Rolled W and WT shapes	A992	Grade 50
Hollow structural sections/HSS: Round, square, or rectangular (including “pipe” where indicated for structural members and supports)	A500	Grade C

2.02 FASTENERS AND STRUCTURAL HARDWARE

A. General:
   1. Materials: Of domestic manufacture.
   2. Where fasteners and hardware are specified to be galvanized, hot-dip galvanize in accordance with ASTM A153 or ASTM F2329, unless otherwise specified.

B. All thread rods:
   1. Carbon steel:
      a. In accordance with ASTM A36 unless otherwise indicated on the Drawings.
      b. Nuts: ASTM A194.
      c. Washers: ASTM F436.
   2. Galvanized carbon steel:
      a. In accordance with ASTM A36 unless otherwise indicated on the Drawings and hot dip galvanized in accordance with ASTM A153.
      b. Nuts: ASTM A194; hot-dip galvanized in accordance with ASTM A153.
      c. Washers: ASTM F436; hot-dip galvanized in accordance with ASTM A153.

C. Anchor bolts, anchor rods, and post-installed steel anchors: As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

D. High-strength bolts:
   1. Provide high-strength bolt assembly with nuts, hardened flat washers, and compressible-washer-type direct tension indicators.
   2. Carbon steel: Uncoated:
      a. Bolts: Plain heavy hex structural bolts in accordance with ASTM F3125, Grade A325, Type 1.
      b. Nuts: Heavy hex nuts in accordance with ASTM A563, Grade C.

c. Washers:
    1) Adjacent to normal, oversized, and short-slotted holes: Circular, square or rectangular beveled, clipped, or extra thick washers in accordance with ASTM F436, Type 1. Flat circular washers unless otherwise indicated on the Drawings.
    2) Adjacent to long slotted holes: Fabricated from 5/16-inch thick plate in accordance with ASTM A36.
d. Load indicator devices: At slip critical connections, provide one of the following devices at each bolt:
    1) Compressible-washer-type direct tension indicators (DTI): In accordance with ASTM F959, Type 325-1.
    2) Twist-off type tension-control bolt assemblies: ASTM F3125, Grade F1852 or ASTM F3125, Grade F2280 where Grade A490 bolts are indicated on the Drawings.

3. Carbon steel: Galvanized:
    a. Bolt and nut assemblies fabricated, galvanized, tested for rotational capacity, and shipped accordance with the provisions ASTM F3125, Grade A325 and the RCSC Specification.
    b. Bolts, nuts, and washers: Hot-dip galvanized in accordance with ASTM F2329.
    c. Bolts: Plain heavy hex structural bolts in accordance with ASTM F3125, Grade A325, Type 1 and galvanized as specified.
    d. Nuts: Heavy hex nuts in accordance with ASTM A563, Grade DH, galvanized as specified, and lubricated in accordance with ASTM A563, Supplementary Requirement S1 to minimize galling.
    e. Washers:
        1) Adjacent to normal, oversized, and short-slotted holes: Circular, square or rectangular beveled, clipped, or extra thick washers in accordance with ASTM F436, Type 1 and galvanized as specified. Flat circular washers unless otherwise indicated on the Drawings.
        2) Adjacent to long slotted holes: 5/16-inch-thick plate washer fabricated from steel in accordance with ASTM A36 and galvanized in accordance with ASTM A123.
    f. Load indicator devices: At slip critical connections, provide one of the following devices at each bolt:
        1) Compressible-washer-type direct tension indicators (DTI): In accordance with ASTM F959, Type 325-1, with mechanically deposited zinc coating in accordance with ASTM B695, Class 55.
        2) Twist-off type tension-control bolt assemblies: ASTM F3125, Grade F1852 with mechanically deposited zinc coating in accordance with ASTM B695, Class 55.

2.03 ISOLATING SLEEVES AND WASHERS

A. As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.04 GALVANIZED SURFACE REPAIR

A. Manufacturers: The following or equal:
    1. Jelt, Galvinox.

2.05 THREAD COATING

A. Manufacturers: One of the following or equal:
   1. Bostik, Never-Seez.
   2. Oil Research, Inc., WLR No. 111.

2.06 SUPPLEMENTARY PARTS

A. Furnish as required for complete structural steel erection, whether or not such parts and Work are specified or indicated on the Drawings.

2.07 FABRICATION

A. Shop assembly:
   1. Fabricate structural steel in accordance with AISC 360 and AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
   2. Where anchors, connections, or other details of structural steel are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.
   3. Round off sharp and hazardous projections and grind smooth.
   4. Take measurements necessary to properly fit work in the field. Take responsibility for and be governed by the measurements and proper working out of all the details.
   5. Take responsibility for correct fitting of metalwork.
   6. Welded connections:
      a. In accordance with AWS requirements for the metals to be welded.
      b. Weld only in accordance with approved welding procedure specifications.
      c. Keep welding procedure specifications readily available for welders and inspectors during fabrication processes.

B. Galvanized carbon steel:
   1. Where galvanizing is required, hot-dip structural steel after fabrication in accordance with ASTM A123.
   2. Do not electro-galvanize or mechanically-galvanize unless specified or accepted by the Engineer.
   3. Re-straighten galvanized items that bend or twist during galvanizing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 ERECTION

A. General:
   1. Fabricate structural and foundry items to true dimensions without warp or twist.

2. Form welded closures neatly and grind off smooth where weld material interferes with fit or is unsightly.
3. Install structural items accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
4. Do not shift out of alignment, re-drill, re-shape, or force fit fabricated items.
5. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and level.
6. Rigidly support and brace components to preserve straight, level, even, and smooth lines.
    a. Install non-shrink grout as indicated on the Drawings.
    b. Keep items braced until grout has hardened for 48 hours minimum.
7. Erect structural steel in accordance with AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
8. Where anchors, connections, and other details of structural steel erection are not specifically indicated on the Drawings or specified, form, locate, and attach with equivalent in quality and workmanship to items specified.
9. Round off sharp or hazardous projections and grind smooth.

B. Welding: General:
1. Make welds full penetration type, unless otherwise indicated on the Drawings.
2. Remove backing bars and weld tabs after completion of weld. Repair defective welds observed after removal of backing bars and weld tabs.

C. Welding: Carbon steel:
1. In accordance with AWS D1.1:
    a. Weld ASTM A36 and ASTM A992 structural steel and ASTM A500 and ASTM A501 structural tubing with electrodes in accordance with AWS A5.1, using E70XX electrodes; AWS A5.17, using F7X-EXXX electrodes; or AWS A5.20, using E7XT-X electrodes.
    b. Field repair cut or otherwise damaged galvanized surfaces to equivalent original condition using a galvanized surface repair.

D. Interface with other products:
1. Where steel members and fasteners come in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals with isolating sleeves and washers as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

E. Fasteners: General:
1. Install bolts to project 2 threads minimum, but 1/2 inch maximum beyond nut.
2. Anchor bolts and anchor rods: Install as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
    a. Unless otherwise specified, tighten nuts on anchor bolts and anchor rods specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry to the “snugtight” condition.
3. All thread rods in drilled holes bonded to concrete with adhesive: Install as specified in Section 03055 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

4. All thread rods in drilled holes bonded to masonry with adhesive: Install as specified in Section 04055 - Adhesive Bonding Reinforcing Bars and All Thread Rods in Masonry.

F. Fasteners: High-strength carbon steel bolts:
   1. Connections with high-strength bolts shall be in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts.
   2. Provide snug-tight joints at bolted connections unless otherwise indicated on the Drawings.
   3. Joints: Slip-critical.
      a. Confirm that faying surfaces at connections are free of dirt and other foreign material, have been blast cleaned, and are free of coatings and inadvertent overspray in accordance with the RCSC Specification.
      b. Furnish hardened flat washers in accordance with ASTM F436:
         1) On outer plies with slotted holes.
         2) When one or more plies of the connected material has a yield strength less than 40 ksi.
         3) Under element, nut, or bolt head, turned in tightening.
      c. Install tension indicator washers, placed in accordance with ASTM F959, Figure X1, to confirm adequate tightening of bolts.
      d. Tighten bolts to full pretension.
   5. Joints: Snugtight:
      e. Install bolts with washers where required in accordance with the RCSC Specification.
      f. Tighten bolts to bring the connected plies into firm contact.
         1) Tightening shall progress systematically beginning with the most rigid part of the joint.
         2) More than 1 cycle through the bolt pattern may be required to achieve this condition.
      g. Verify adequate tightening of bolts by visual observation to confirm that washers have been installed at locations required in accordance with the RCSC Specification and that the plies of the connected parts have been brought into firm contact.

3.03 FIELD QUALITY CONTROL

A. As specified in Section 01450 - Quality Control.

3.04 FIELD QUALITY ASSURANCE

A. As specified in Section 01450 - Quality Control.

B. Special inspections, special tests, and structural observation:
   1. As specified in Section 01455 - Regulatory Quality Assurance.

END OF SECTION

SECTION 05190

MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for:
   1. Post-installed steel anchors and fasteners.
   2. Appurtenances for anchoring and fastening.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete & Commentary.

B. American National Standards Institute (ANSI):
   1. B212.15 - Cutting Tools - Carbide-tipped Masonry Drills and Blanks for Carbide-tipped Masonry Drills.

C. ASTM International (ASTM):
   1. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   2. B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
   3. F436 - Standard Specification for Hardened Steel Washers.
   4. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
   5. F594 - Standard Specification for Stainless Steel Nuts.
   6. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
   7. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

D. International Code Council Evaluation Service, Inc. (ICC-ES):
   1. AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

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. Built-in anchor: Headed bolt or assembly installed in position before filling surrounding masonry units with grout.
   2. Overhead installations: Fasteners installed on overhead surfaces where the longitudinal axis of the fastener is more than 45 degrees above a horizontal line so the fastener resists sustained tension loads.

3. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.
4. Post-installed anchor: Fastener or assembly installed in hardened concrete or finished masonry construction, typically by drilling into the structure and inserting a steel anchor assembly.
    a. Other locations:
        1) Interior dry areas where the surfaces are not exposed to moisture or humidity in excess of typical local environmental conditions.

1.04 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures.

B. Calculations.
1. Submit structural calculations stamped by a Professional Engineer registered in the State of Utah.

1.05 SUBMITTALS

A. General:
1. Submit as specified in Section 01330 - Submittal Procedures and Section 01600 - Product Requirements.

B. Product data:
1. Post-installed anchors:
    a. For each anchor type, manufacturer's data, including catalog cuts showing anchor sizes and construction, materials and finishes, and load ratings.

C. Delegated Design Submittals:
1. When requesting product substitutions for post installed anchors, submit calculations, indicating the diameter, effective embedment depth and spacing of the proposed anchors, and demonstrating that the substituted product will provide load resistance that is equal to or greater than that provided by the anchors listed in this Section.

D. Samples:
1. Samples of each type of anchor, including representative diameters and lengths, if requested by the Engineer.

E. Certificates:
1. Post-installed anchors:
    a. Manufacturer's statement or certified test reports demonstrating that anchors that will be supplied to the Site comply with the materials properties specified.

F. Test reports:
   1. Post-installed anchors: For each anchor type used for the Work:
      a. Current ICC-ES report (ESR) or equivalent acceptable to the Engineer and the authority having jurisdiction, demonstrating:
         1) Acceptance of that anchor for use under the building code specified in Section 01410 - Regulatory Requirements.
         2) That testing of the concrete anchor included the simulated seismic tension and shear tests of AC193, and that the anchor is accepted for use in Seismic Design Categories C, D, E, or F, and with cracked concrete.

G. Manufacturer's instructions:
   1. Requirements for storage and handling.
   2. Recommended installation procedures, including details on drilling, hole size (diameter and depth), hole cleaning and preparation procedures, anchor insertion, and anchor tightening.
   3. Requirements for inspection or observation during installation.

H. Qualification statements:
   1. Post-installed anchors: Installer qualifications:
      a. Submit list of personnel performing installations. Include letter of training from manufacturer indicating date of manufacturer's training for each installer.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Post installed anchors shall be in accordance with building code specified in Section 01410 - Regulatory Requirements.

B. Special inspection:
   1. Provide special inspection of post-installed anchors as specified in Section 01455 - Regulatory Quality Assurance and this Section, and in accordance with the product's current ICC-ES report (ESR) or equivalent acceptable to the Engineer and the authority having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 01600 - Product Requirements.

B. Deliver post-installed anchors in manufacturer's standard packaging with labels visible and intact. Include manufacturer's installation instructions.

C. Handle and store anchors and fasteners in accordance with manufacturer's recommendations and as required to prevent damage.

D. Protect anchors from weather and moisture until installation.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

B. Seismic Design Category (SDC) for structures is indicated on the Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. General:
   1. Furnish threaded fasteners with flat washers and hex nuts fabricated from materials corresponding to the material used for threaded portion of the anchor.
      a. Post-installed anchors: Provide flat washers and nuts supplied for that product by the manufacturer of each anchor.
   2. Size of anchors and fasteners, including diameter and length or minimum effective embedment depth: As indicated on the Drawings or as specified in this Section. In the event of conflicts, contact the Engineer for clarification.
   3. Where anchors and connections are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.

2.02 POST-INSTALLED ANCHORS AND FASTENERS - ADHESIVE

A. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in concrete: As specified in Section 03055 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

B. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in masonry: As specified in Section 04055 - Adhesive Bonding Reinforcing Bars and All Thread Rods in Masonry.

2.03 APPURTENANCES FOR ANCHORING AND FASTENING

A. Coating for repair of galvanized surfaces:
   1. Manufacturers: The following or equal:
      a. Jelt, Galvinox.

B. Thread coating: For use with threaded stainless steel fasteners:
   1. Manufacturers: One of the following or equal:
      a. Bostik, Never-Seez.
      b. Oil Research, Inc., WLR No. 111.

C. Steel plates or shapes for fabrications:
   1. Galvanized steel:
      a. Hot dip galvanized in accordance with ASTM A123.
      b. Steel: ASTM A36.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION - GENERAL

A. Where anchors and fasteners are not specifically indicated on the Drawings or specified, make attachments with materials specified in this Section.

B. Protect products from damage during installation. Protect threads and threaded ends.

C. Accurately locate and position anchors and fasteners:
   1. Unless otherwise indicated on the Drawings, install anchors perpendicular to the surfaces from which they project.
   2. Install anchors so that at least 2 threads, but not more than 1/2 inch of threaded rod, projects past the top nut.

D. Interface with other products:
   1. Prior to installing nuts, coat threads of galvanized fasteners with thread coating to prevent galling of threads.

3.03 INSTALLATION - POST-INSTALLED ADHESIVE ANCHORS

A. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in concrete: As specified in Section 03055 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

B. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in masonry: As specified in Section 04055 - Adhesive Bonding Reinforcing Bars and All Thread Rods in Masonry.

3.04 FIELD QUALITY CONTROL

A. Provide quality control over the Work of this Section as specified in Section 01450 - Quality Control.
   1. Expenses associated with Work described by the following paragraphs shall be paid by the Contractor.

B. Post-installed anchors:
   1. Review anchor manufacturer’s installation instructions and requirements of the Evaluation Service report (hereafter referred to as “installation documents”) for each anchor type and material.
   2. Observe hole-drilling and cleaning operations for conformance with the installation documents.
   3. Certify in writing that the depth and location of anchor holes, and the torque applied for setting the anchors conforms to the requirements of the installation documents.

3.05 FIELD QUALITY ASSURANCE

A. Owner's representative will provide on-site inspection and field quality assurance for the Work of this Section.
   1. Expenses associated with work described by the following paragraphs shall be paid by the Owner.

B. Field inspections and special inspections:
   1. Required inspections: Observe construction for conformance to the approved Contract Documents, the accepted Submittals, and the manufacturer's installation instructions, and the current ICC-ES report (ESR) or equivalent acceptable to the Engineer and the authority having jurisdiction, demonstrating:
   2. Record of inspections:
      a. Maintain record of each inspection.
      b. Submit copies to the Engineer upon request.
   3. Verification of special inspections: At the end of the Project, prepare and submit to the Engineer and the authority having jurisdiction inspector's statement that the Work was constructed in general conformance with the approved Contract Documents, and that deficiencies observed during construction were resolved.

C. Field tests:
   1. Owner's Representative may, at any time, request testing to confirm that materials being delivered and installed conform to the requirements of the Specifications.
      a. If such additional testing shows that the materials do not conform to the specified requirements, the Contractor shall pay the costs of these tests.
      b. If such additional testing shows that the materials do conform to the specified requirements, the Owner shall pay the costs of these tests.
   2. Post-installed anchors:
      a. Proof load testing:
         1) In addition to performing special inspections, the Engineer may select up to 10 percent of each type and size of post-installed mechanical anchor for proof-load testing for pullout or shear. Tests shall be non-destructive whenever possible.
         2) Perform tension testing in accordance with ASTM E488. Apply proof loads using a calibrated hydraulic ram.
      b. Torque load testing:
         1) Using a calibrated torque wrench, apply manufacturer's recommended installation torque. Do not exceed the maximum torque listed by the manufacturer.
      c. Acceptance criteria:
         1) Minimum anchor embedment, proof load for pullout and shear, and torque shall be as specified in this Section.
         2) Anchors that fail to resist their designated proof load or installation torque requirements shall be regarded as non-performing.
         3) If more than 10 percent of the tested anchors fail to achieve their specified torque or proof load, all anchors of the same diameter and type as the failed anchors shall be tested.

4) Remediate non-performing anchors as specified in “non-conforming work.”

3.06 NON-CONFORMING WORK

A. Remove misaligned or non-performing anchors.

B. Fill empty anchor holes and repair failed anchor locations using non-shrink cement grout as specified in Section 03600 - Grouting, unless otherwise directed by the Engineer.

C. If more than 10 percent of all tested anchors of a given diameter and type fail to achieve their specified torque or proof load, the Engineer will provide directions for required modifications. Make such modifications, up to and including replacement of all anchors, at no additional cost to the Owner.

3.07 SCHEDULES

Galvanized: Provide and install galvanized carbon steel anchors at all locations, unless noted otherwise in the Drawings.

END OF SECTION

SECTION 16050

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.

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 job site.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - 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. Meetings:
   1. As specified in Section 01312 - Project Meetings.

C. 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 01850 - 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 05190 - 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:
      a. Conduit installation requirements: As specified in Section 16130 - Conduits.

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 16130 - Conduits)	Support Materials
Admin Building	C	12	GRC	GALV STL
Chemical Building	C	12	GRC	GALV STL
Headworks	C	12	GRC	GALV STL
RAS/WAS	C	12	GRC	GALV STL
Utility Water Pumping Station	C	12	GRC	GALV STL
Solids and Handling	C	12	GRC	GALV STL
Exterior Locations	W	4X SST	PCS	SST

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. Disconnect electrical equipment.
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.
4. Salvage electrical equipment as specified in Section 01738 - Selective Alterations and Demolition.
5. For each piece of equipment to be removed, remove ancillary components (e.g., instruments, solenoid valves, disconnect switches, etc.).
6. Conduit:
    a. Where conduit removal, other than associated with equipment to be removed, is 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.
    b. 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.
7. Remove wire back to the source for conduits to be removed or abandoned in place.
8. Provide new nameplates for modified electrical distribution equipment, motor control centers etc., to identify equipment and circuits that are no longer used as spares.
9. 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. 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 16950 - 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 16070

HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Mounting and supporting electrical equipment and components.

1.02 REFERENCES

A. American National Standards Institute (ANSI).

B. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

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. Anchor: Elements (including hardware) connecting hangers and supports to the structure.
   2. Hardware: Nuts, bolts, straps, clamps, threaded rod, etc.
   3. Supports: Preformed channel or other structural member on which the electrical equipment or raceway is mounted.

1.04 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures.

B. Anchoring and bracing.

1.05 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Supports:
      a. Materials.
      b. Geometry.
      c. Manufacturer.
   2. Hardware:
      a. Materials.
      b. Manufacturer.

C. Shop Drawings:
   1. Dimensioned and scalable Shop Drawings of hangers and supports for distribution systems and equipment.
   2. Complete details for:
      a. Member sizes and arrangement in hangers and support assemblies.
      b. Connections between members in hangers and support assemblies.
      c. Anchoring hangers and supports to structures.
      d. Bracing for hangers and supports and anchoring of bracing to structures.
   3. Include data on connections, attachment hardware and construction to demonstrate that hangers and supports will satisfy the design loading, bracing, and anchoring criteria.

D. Delegated Design Submittals:
   1. Hangers and supports - General:
      a. Locations and conditions:
         1) Hangers and supports inside structures.
         2) Hangers and supports that resist cable pulling/rigging loads.
      b. Required Submittals: Details with supporting calculations for:
         1) Support member arrangement, sizes, and connections.
         2) Bracing to resist cable pulling/rigging loads.
         3) Connections of hangers, supports, and bracing to the structure.
         4) Connections between supports and the equipment or raceway(s) thereon.
   2. Hangers and supports - Exterior and seismic conditions:
      a. Locations and conditions:
         1) Hangers and supports at structures designated as Seismic Design Category (SDC) C, D, E, or F in Section 01850 - Design Criteria.
         2) Hangers and supports for outdoor installations.
      b. Required Submittals:
         1) Interior: Bracing to resist seismic design loads specified in Section 01850 - Design Criteria.
         2) Exterior: Bracing to resist seismic, wind, and other environmental loads specified in Section 01850 - Design Criteria.
   3. Hangers and supports anchored to concrete and masonry:
      a. Locations and conditions:
         1) Post-installed mechanical anchors in tension.
         2) Post-installed adhesive-bonded all-thread rods in tension.
      b. Required Submittals:
         1) Calculations demonstrating that anchors have a demand/capacity ratio (D/C) not greater than the following when anchor capacity is adjusted for moisture conditions, anchor spacing and edge distances, and sustained loading conditions present at the location of installation.
            a) Post-installed mechanical anchors maximum: 85 percent.
            b) Post-installed adhesive-bonded anchors maximum: 75 percent.

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 01850 - Design Criteria.

1.09 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. Mount raceways, cabinets, boxes, fixtures, instruments, and devices on Contractor-fabricated supports unless otherwise indicated on the Drawings.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Hangers and supports individually and as a system shall resist weights and code-required forces without deflections and deformations that would damage the supporting elements, the raceway or equipment supported, or the surrounding construction.
   1. Provide the necessary sway bracing to keep support structures from swaying due to lateral forces, including wire and cable pulling forces.
   2. Lateral deflection at top of slab mounted supports shall not exceed support height divided by 240, unless otherwise approved by the Engineer.

2.03 MANUFACTURERS

A. One of the following or equal:
   1. Preformed channel:
      a. Eaton B-line.
      b. Power-Strut.
      c. Robroy.
      d. Tyco.
      e. Unistrut.

2.04 MATERIALS

A. Hot dip galvanized steel:
   1. Supports:
      a. In accordance with ASTM A123 or A153.
      b. Minimum zinc coating thickness of 2.5 mils.
      c. Nominal dimensions: 1-5/8 inch by 1-5/8 inch.
   2. Hardware:
      a. Electro-galvanized.
      b. In accordance with ASTM A153.

B. Stainless steel:
    1. Supports:
        a. In accordance with ASTM A240.
        b. ANSI Type 316 material.
        c. Nominal dimensions: 1-5/8 inch by 1-5/8 inch.
    2. Hardware:
        a. ANSI Type 316 material.

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS

A. Fabricated metal supports: As specified in Section 05120 - Structural Steel Framing.

2.08 ACCESSORIES

A. Anchors:
    1. As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

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. Use materials appropriate for the area as specified in Section 16050 - Common Work Results for Electrical.

B. General:
    1. Refer to the Drawings for details. Equipment, cabinets, boxes, instruments, and devices in damp or wet locations on minimum of 7/8-inch preformed mounting channel.
    2. Mount channel vertically along the length of the device so that water or moisture may run freely behind the device.

C. Corrosion protection:
   1. Isolate dissimilar metals, except where required for electrical continuity.
      a. Use neoprene washers, 9-mil polyethylene tape, or gaskets for isolation.

D. Anchoring methods:
   1. Solid concrete:
      a. Anchor bolts, anchor rods or post-installed anchors as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
   2. Metal surfaces: Machine screws or bolts.
   3. Hollow masonry units:
      a. Post installed anchors as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
   4. Wood and metal studs:
      a. When supporting devices on metal or wood stud construction, bridge studs with preformed channel, and mount the devices to the channel.

E. Recoat or seal drilled holes, cut or scratched surfaces or with products recommended by the manufacturer.

F. Group raceway and position on racks to minimize crossovers.

END OF SECTION

SECTION 16075

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 01330 - 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 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

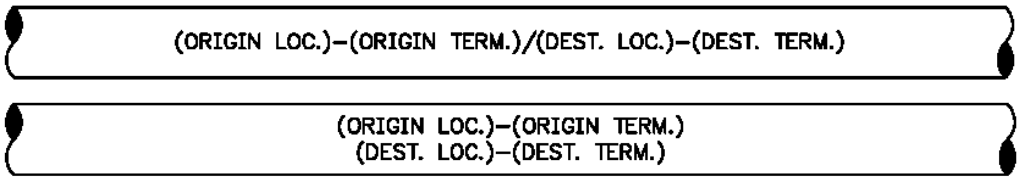
2.01 GENERAL

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 16130 - 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.



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.

C. Conduit and raceway markers:
    1. Non-metallic: One of the following or equal:
        a. Almetek: Mini Tags.

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. 3/32-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.

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.

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.

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 the Engineer 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 16123

600-VOLT OR LESS WIRES AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. 600-volt class or less wire and cable.

1.02 REFERENCES

A. Abbreviations:
   1. AWG: American wire gauge.
   2. BCCS: Bare copper-covered steel.
   3. CPE: Chlorinated polyethylene.
   4. FHDPE: Foam high-density polyethylene.
   5. FPE: Foam polyethylene.
   6. OD: Outside diameter.
   7. PVC: Polyvinyl chloride.
   8. XHHW: Cross-linked high heat water resistant insulated wire.

B. Standards:
   1. ASTM International (ASTM):
      a. B3 - Standard Specification for Soft or Annealed Copper Wire.
      b. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
   2. CSA International (CSA).
   3. Insulated Cable Engineers Association (ICEA):
      a. S-90-661 - Individually Unshielded Twisted Pair Indoor Cables for Use in Communication Wiring Systems.
   4. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
      a. NEMA WC 66/ICEA S-116-732 - Standard for Category 6 and 6A, 100 Ohm, Individually Unshielded Twisted Pairs, Indoor Cables (With or Without an Overall Shield) for Use in LAN Communication Wiring Systems.
      b. NEMA WC 70/ICEA S-95-658-1999 - Standard for Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
   5. National Fire Protection Association (NFPA):
      a. 70 - National Electrical Code (NEC).
      b. 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
   6. Telecommunications Industry Association (TIA):
      a. 568.2-D - Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
      b. 569-B - Commercial Building Standards for Telecommunications Pathways and Spaces.

7. Underwriters Laboratories Inc. (UL):
    a. 44 - Standard for Thermoset-Insulated Wires and Cables.
    b. 1666 - Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.

1.03 DELEGATED DESIGN (NOT USED)

1.04 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
1. Manufacturer of wire and cable.
2. Insulation:
    a. Type.
    b. Voltage class.
3. AWG size.
4. Conductor material.
5. Pulling compounds.

C. Shop Drawings:
1. Show splice locations.
    a. For each proposed splice location provide written justification describing why the splice is necessary.
2. Wire and cable pulling plan:
    a. Provide a pull plan sketch identifying each segment of the pulling calculations, mechanical pulling equipment, and wire/cable spool locations.

D. Test reports:
1. Submit test reports for meg-ohm tests.

E. Calculations:
1. Submit cable pulling calculations to the Engineer for review and comment for cables that will be installed using mechanical pulling equipment. Show that the maximum cable tension and sidewall pressure will not exceed manufacturer recommended values:
    a. Provide a table showing the manufacturer’s recommended maximum cable tension and sidewall pressure for each cable type and size included in the calculations.
    b. Submit the calculations to the Engineer a minimum of 2 weeks before conduit installation.
    c. Provide the wire and cable pulling plan identified under Shop Drawings with the cable pulling calculations Submittal.

F. Cable lengths:
1. Submit installed cable lengths using a conduit measuring tape for 3-phase circuits.
2. Submit installed lengths of cable for the following single-phase circuits:
    a. Circuits feeding single-phase transformers.
    b. Circuits feeding single-phase panelboards.

1.05 QUALITY ASSURANCE

A. Wires and cables shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

A. General Site and Project conditions:
   1. As specified in Section 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. Color-coding:
   1. Color-coding shall be consistent throughout the facility.
   2. The following color code shall be followed for 240/120-volt and 208/120-volt systems:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Single phase system: Black for 1 hot leg, red for the other.
      e. Neutral: White.
      f. High phase or wild leg: Orange.
      g. Equipment ground: Green.
   3. The following color code shall be followed for 480/277-volt systems:
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Neutral: Gray.
      e. Equipment ground: Green.
   4. The following color code shall be followed for 120 VAC control wiring:
      a. Power: Red.
      b. Neutral: White.
   5. The following color code shall be followed for general purpose DC control circuits:
      a. Grounded conductors: White with blue stripe.
      b. Ungrounded conductors: Blue.
   6. Switch legs shall be violet. 3-way switch runners shall be pink.
   7. Wires in intrinsically safe circuits shall be light blue.

8. Wire colors shall be implemented in the following methods:
    a. Wires manufactured of the desired color.
    b. Continuously spiral wrap the first 6 inches of the wire from the termination point with colored tape:
        1) Colored tape shall be wrapped to overlap half of the width of the tape.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Furnish and install the complete wire and cable system.

2.03 MANUFACTURERS

A. One of the following, or equal:
    1. 600-volt class wire and cable:
        a. Okonite Co.
        b. Prysmian General Cable.
        c. Service Wire.
        d. Southwire Co.
    2. Instrumentation class wire and cable:
        a. Alpha Wire Co.
        b. Belden CDT.
        c. Okonite Co.
        d. Prysmian General Cable.
        e. Rockbestos Surprenant Cable Corp.
    3. Network cables:
        a. Belden.
        b. CommScope.
        c. General Cable.
    4. Locomotive cable:
        a. Southwire Co.
        b. Prysmian.

2.04 MATERIALS

A. Conductors:
    1. Copper in accordance with ASTM B3.

2.05 MANUFACTURED UNITS

A. General:
    1. Provide new wires and cables manufactured within 1 year of the date of delivery to the Site.
    2. Permanently mark each wire and cable with the following at 24-inch intervals:
        a. AWG size.
        b. Voltage rating.
        c. Insulation type.
        d. UL symbol.
        e. Month and year of manufacture.
        f. Manufacturer’s name.

3. Identify and mark wire and cable as specified in Section 16075 - Identification for Electrical Systems:
    a. Use integral color insulation for #2 AWG and smaller wire.
    b. Wrap colored tape around cable larger than #2 AWG.

B. 600-volt class wire and cable:
1. Provide AWG or kcmil sizes as indicated on the Drawings or in the Conduit Schedules:
    a. When not indicated on the Drawings, size wire as follows:
        1) In accordance with the NEC:
            a) Use 75-degree Celsius ampacity ratings.
            b) Ampacity rating after derating factors, equal to or greater than rating of the overcurrent device.
        2) Provide #12 AWG minimum for power conductors.
        3) Provide #14 AWG minimum for control conductors.
2. Provide Class B stranding in accordance with ASTM B8:
    a. Provide Class C stranding where extra flexibility is required.
3. Insulation:
    a. XHHW-2.
    b. 90-degree Celsius rating.
4. Shielding:
    a. Individual pair/triad:
        1) Minimum 1.35-mil double-faced aluminum foil-polyester tape overlapped to provide 100 percent coverage.
    b. Multiple pair or triad shielding:
        1) Group shield: Minimum 1.35-mil double-faced aluminum foil-polyester tape overlapped to provide 100 percent coverage.
        2) Completely isolate group shields from each other.
        3) Cable shield: 2.35-mil double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage.
    c. Shielding to be in contact with the drain wire.

C. Network cables:
1. Copper Ethernet cable:
    a. Provide copper Ethernet cable types as indicated on the Drawings and Specifications.
    b. General requirements:
        1) Cables shall meet the standards set by TIA-568.2-D and verified by third-party testing laboratory.
        2) Conductors:
            a) 4 balanced twisted pairs.
                (1) #22 to #24 AWG thermoplastic insulated solid copper conducts enclosed by a thermoplastic jacket. Copper clad aluminum is not allowed.
        3) Insulation:
            a) Non-Plenum: Polyolefin.
            b) Plenum: Fluoropolymer.
        4) Color coded per T568B.
        5) Outer jacket with ripcord.

6) Shielding:
   a) Provide F/UTP cables with drain wire for cables inside any equipment or enclosure with 480 VAC and above, outdoor installations, and where indicated on the Drawings.
7) Voltage rating:
   a) At a minimum provide 300 VAC rated jacket.
   b) 600 VAC rated jacket when cables are inside equipment or enclosures that contain 480 VAC power.
8) Approvals and listings:
   a) Meets NEC requirements for each application.
   b) Riser applications: Type CMR.
   c) Plenum applications: Type CMP.
   d) Limited-use applications: Type CMX.
9) Certification:
   a) Provide Category 5e cables with ICEA S-90-661 certification.
   b) Provide Category 6 cables with NEMA WC 66/ICEA S-116-732 certification.
   c) Provide Category 6A cables with NEMA WC 66/ICEA S-116-732 certification.

D. Locomotive cable:
   1. Provide sizes as indicated on the Drawings.
   2. Conductors:
      a. Tin coated copper.
      b. Class I fully annealed.
   3. Insulation:
      a. 2000-volt EPR or EPDM insulation.
      b. CPE jacket.
      c. 90 degrees Celsius rated.
   4. Listed as RHH/RHW-2 in accordance with UL 44.

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES

A. Wire ties:
   1. One of the following, or equal:
      a. Panduit, cable ties.
      b. T&B, “Ty-Rap” cable ties.

B. Wire markers:
   1. As specified in Section 16075 - Identification for Electrical Systems.

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Assembly and testing of cable shall be in accordance with the applicable requirements of NEMA WC 70/ICEA S-95-658-1999.

B. Test type XHHW-2 in accordance with the requirements of UL 44.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install conductors only after the conduit installation is complete, and enclosures have been vacuumed clean, and the affected conduits have been swabbed clean and dry:
   1. Install wires only in approved raceways.
   2. Do not install wire:
      a. In incomplete conduit runs.
      b. Until after the concrete work and plastering is completed.

B. Properly coat wires and cables with pulling compound before pulling into conduits:
   1. For #4 AWG and larger, use an approved wire-pulling lubricant while cable is being installed in conduit:
      a. Ideal Products.
      b. Polywater Products.
      c. 3M Products.
      d. Greenlee Products.
      e. Or equal, as recommended by cable manufacturer.
      f. Do not use oil, grease, or similar substances.

C. Cable pulling:
   1. Prevent mechanical damage to conductors during installation.
   2. For cables #1 AWG and smaller, install cables by hand.
   3. For cables larger than #1 AWG, power pulling winches may be used if they have cable tension monitoring equipment.
   4. Provide documentation that maximum cable pulling tension was no more than 75 percent of the maximum recommended level as published by the cable manufacturer. If exceeded, the Engineer may, at his discretion, require replacement of the cable.
   5. Ensure cable pulling crews have calculations and cable pulling limitations while pulling cable.
   6. Make splices or add a junction box or pullbox where required to prevent cable pulling tension or sidewall pressure from exceeding 75 percent of the manufacturer's recommendation for the specified cable size:
      a. Make splices in manholes or pull boxes only.
      b. Leave sufficient slack to make proper connections.

D. Use smooth-rolling sheaves and rollers when pulling cable into cable tray to keep pulling tension and bending radius within the manufacturer's recommendations.

E. Install and terminate wire in accordance with the manufacturer's recommendations.
   1. Use lugs specifically made for fine stranded conductors when terminating locomotive cable.

F. Neatly arrange and lace conductors in switchboards, panelboards, pull boxes, and terminal cabinets by means of wire ties:
   1. Do not lace wires in gutter or panel channel.
   2. Install wire ties with a flush cutting wire tie installation tool:
      a. Use a tool with an adjustable tension setting.
   3. Do not leave sharp edges on wire ties.

G. Terminate stranded conductors on equipment box lugs such that conductor strands are confined within the lug:
   1. Use ring type lugs if box lugs are not available on the equipment.

H. Lighting circuits:
   1. Each circuit shall have a dedicated neutral.

I. Splices:
   1. Provide continuous circuits from origin to termination whenever possible:
      a. Obtain the Engineer's approval prior to making any splices.
   2. Lighting and receptacle circuit conductors may be spliced without prior approval from the Engineer.
   3. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths:
      a. Splice box NEMA rating requirements as specified in Section 16050 - Common Work Results for Electrical.
      b. Make splices in labeled junction boxes for power conductors.
      c. Make splices for control and instrument conductors in terminal boxes:
         1) Provide terminal boards with setscrew pressure connectors, with spade or ring lug connectors.
   4. Power and control conductors routed in common raceways may be spliced in common junction boxes.
   5. Clearly label junction and terminal boxes containing splices with the words "SPLICE LOCATED WITHIN".
   6. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.
   7. Install splices with compression type butt splices and insulate using a heat-shrink sleeve:
      a. In NEMA Type 4 or NEMA Type 4X areas, provide heat-shrink sleeves that are listed for submersible applications.
   8. Splices in below grade pull boxes, in any box subject to flooding, and in wet areas shall be made waterproof using:
      a. A heat shrink insulating system listed for submersible applications.
      b. Or an epoxy resin splicing kit.

J. Apply wire markers to wires at each end after being installed in the conduit and before meg-ohm testing and termination.

K. Copper Ethernet cables:
   1. In accordance with TIA-568.2-D.
   2. Pathways:
      a. For initial installation, the maximum fill capacity for pathways (i.e., conduit, raceways, trays, baskets) is 40 percent. The maximum fill capacity of 60 percent is allowed to accommodate future additions after initial installation.
      b. Conduit should be run in the most direct route possible with no more than two 90-degree bends between pull boxes and serve no more than 3 outlet boxes.
   3. Cable bend radius:
      a. Proper cable bend radius control must be maintained throughout the pathways. Bend radius needs to be at a minimum 10 times the cable diameter.
   4. Cable pulling:
      a. Provide cable pulling swivel system to prevent winding and tangling of rope and cables during pull.
      b. Maximum pulling tension is not to exceed the manufacturer's recommendations. Cable installation should not in any way deform the cable jacket.
      c. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   5. Cable management:
      a. Organize and manage cables for quick and easy moves, adds and changes.
   6. Cable termination:
      a. Install equipment outlet connector hardware (e.g., RJ45, M12, etc.), and connect to field equipment outlet (e.g., instrument, VFD, actuator, etc.).
      b. Use shielded connectors as required by the installation.
      c. Coordinate cable termination at copper patch panels with ICSC and General Contractor.
   7. Testing:
      a. Copper Ethernet cable testing requirements as specified in Section 16950 - Field Electrical Acceptance Tests.
   8. Separation from EMI sources:
      a. In accordance with TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
      b. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
         1) Electrical equipment rating less than 2 kVA: A minimum of 5 inches.
         2) Electrical equipment rating between 2 and 5 kVA: A minimum of 12 inches.
         3) Electrical equipment rating more than 5 kVA: A minimum of 24 inches.
      c. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
         1) Electrical equipment rating less than 2 kVA: A minimum of 2-1/2 inches.

2) Electrical equipment rating between 2 and 5 kVA: A minimum of 6 inches.
3) Electrical equipment rating more than 5 kVA: A minimum of 12 inches.

d. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
1) Electrical equipment rating less than 2 kVA: No requirement.
2) Electrical equipment rating between 2 and 5 kVA: A minimum of 3 inches.
3) Electrical equipment rating more than 5 kVA: A minimum of 6 inches.

e. Separation between communications cables and electrical motors and transformers, 5 kVA or HP and larger: A minimum of 48 inches.

L. Wiring allowances:
1. Equipment locations may vary slightly from the Drawings. Include an allowance for necessary conductors and terminations for motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of locations indicated on the Drawings.
2. Locations for pull boxes, manholes, and duct banks may vary slightly from the Drawings. Include an allowance for necessary conductors and related materials to provide conductors to pull boxes, manholes and duct banks within 20-linear feet of locations indicated on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Field electrical acceptance testing:
1. As specified in Section 16950 - Field Electrical Acceptance Tests.

END OF SECTION

SECTION 16125

FIBER OPTIC CABLE AND APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fiber optic cable.
   2. Fiber splices and terminations.
   3. Accessories.

1.02 REFERENCES

A. Abbreviations:
   1. N/Cm: Newtons per centimeter.
   2. OLTS: Optical Loss Test Set (Tier 1 test).
   3. OTDR: Optical Time Domain Reflectometer (Tier 2 test).

B. Standards:
   1. Bellcore Standards:
      a. GR-409 - Generic Requirements for Indoor Fiber.
   2. Electronic Industry Association (EIA):
      a. FOTP-25 - Impact testing of Fiber Optic Cables and Cable Assemblies.
      b. FOTP-33 - Fiber Optic Cable Tensile Loading and Bending Test.
      c. FOTP-41 - Compressive Loading Resistance of Fiber Optic Cables.
      d. FOTP-81 - Compound Flow (Drip) Test for Filled Fiber Optic Cable.
      e. FOTP-104 - Fiber Optic Cable Cyclic Flexing Test.
      f. FOTP-181 - Lightning Damage Susceptibility Test for Fiber Optic Cables with Metallic Components.
   3. Insulated Cable Engineer's Association (ICEA):
      a. S-83-596 - Optic Fiber Premises Distribution Cables.
      b. S-87-640 - Optic Fiber Outside Plant Communications Cable.
      c. S-104-696 - Indoor-Outdoor Optic Fiber Cable.
   4. TIA/EIA Standards:
      a. 598 - Optical Fiber Cable Color Coding.
      b. 11801 - Information technology - Generic cabling for customer premises.
   5. Underwriters Laboratories, Inc. (UL):
      a. 1666 - Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.
      b. 1685 - Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.

1.03 TERMINOLOGY

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 DELEGATED DESIGN (NOT USED)

1.05 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Complete manufacturer's brochures that identify materials and options.
   2. Completed datasheets, including catalog number and source for determining catalog number.
   3. Manufacturer's installation instructions.
   4. Include the following:
      a. Manufacturer's data on testing equipment used on this Project.
      b. Manufacturer's specifications and datasheets for all fiber types.
      c. Manufacturer's specifications and datasheets for all connectors, bulkheads, splicing kits, breakout devices, and appurtenances used in connecting and terminating fiber spans.
   5. Catalog data on testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the NIST.
   6. Manufacturer's test procedures and quality assurance procedures:
      a. After review, the Engineer may require that additional tests be performed before installation.

C. Shop Drawings:
   1. Interconnection cabling diagrams for the complete system, including every fiber in each cable.
   2. Drawings indicating locations of all pull boxes, including pull box identifiers and lengths.
   3. Submit optical power budget calculations for fiber segments. Include the following:
      a. Minimum transmit power of active devices.
      b. Minimum receive sensitivity.
      c. Available power, in dBm.
      d. Loss for each segment in dBm, including cable attenuation and connector losses. Use manufacturer's data for cable attenuation at the wavelength to be used. Assume 0.5 dB per connector.
      e. Demonstrate that remaining power budget at each receiver is equal to or greater than 3.0 dBm.

D. Calculations:
   1. Cable pulling calculations for conduit runs:
      a. Indicate on the Submittal any additional pull boxes that are required, including pull box identifiers and a written description of the location.

E. Installation instructions:
   1. Submit a cable pulling and splicing work plan that includes the following:
      a. Pull tension calculations.
      b. Detailed description of pull operation methods for conduit runs.
      c. Tools and equipment to be used for cable installation and testing.
      d. Physical location of equipment setup and type.
      e. Exact locations of splice points.

f. Safety and manual assist cable-pulling operations.
g. Detailed schedule for pulling and testing cables.
h. Name and qualifications of the supervisory personnel directly responsible for installation of the conduit system.
i. Sample fiber optic cable test sheets.
j. Signed test sheet results.

F. Test reports:
1. Submit results of specified tests to the Engineer.
2. Submit 3 copies of test reports showing results of tests specified in this Section or in Section 16950 - Field Electrical Acceptance Tests:
a. Test forms shall include the following information at a minimum:
1) Test type.
2) Test location.
3) Test date.
4) Wavelength.
5) Index of refraction.
6) Cable identification.
7) Fiber type.
8) Fiber number.
9) Fiber color.
10) Result of the value of the tested parameter.
3. Furnish hard copy and electronic copy for OTDR traces.
4. Submit certification that the fiber optic cable has passed each testing stage:
a. Submit separate documentation for each testing stage result.

G. Record documents:
1. Furnish updated electrical drawings, network diagrams, and fiber cable block diagrams at the end of construction and submit as record drawings.

1.06 QUALITY ASSURANCE

A. Furnish cable and appurtenances manufactured within 1 year of installation.

B. Proof test optical fibers by the fiber manufacturer at a minimum load of 50 kpsi.

C. Provide 100 percent attenuation testing for optical fibers:
1. Include with each cable reel the attenuation of each fiber.

D. Provide information on at least 5 successful fiber optic cable installations of comparable size and complexity in the past 3 years with name, address, and telephone number of facility owner, name of project with completion date, and type of conduit system and length of cable pulled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package cable for shipment on wooden reels:
1. Seal both ends of cable to prevent ingress of moisture.
2. Place fiber cable assemblies on reels such that both cable ends are available for testing.

3. Weatherproof cable reel markings shall include the following:
    a. Manufacturer.
    b. Date of manufacture.
    c. Shipping date.
    d. Cable identification.
    e. Cable configuration/fiber count.
    f. Cable length.
    g. Gross weight.
    h. Cable test date.
    i. Handling instructions.
    j. Direction to unreel.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:
    1. Submit a cable pulling and splicing work plan a minimum of 45 days before the planned initiation of cable pulling. Cable pulling and splicing work plan must be approved a minimum of 15 days before pulling cable.
    2. Testing sequence:
        a. Perform testing of each fiber in each cable as follows:
            1) At factory before shipment.
            2) At Project Site upon delivery.
            3) Submit copies of test results to the Engineer within 5 days after the delivery to the Site.
            4) After installation, before breakout and terminations.
            5) After installation is complete.
        b. Submit test reports following each set of tests as specified in this Section.

B. Scheduling:
    1. Schedule Engineer, 5 days before installation, to witness cable installations.
    2. Notify the Engineer and Owner a minimum of 15 days before post-installation testing.

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Install fiber optic system components in accordance with the recommendations of the manufacturer.

2.03 MANUFACTURERS

A. Acceptable manufacturers are indicated with each component type as listed in the remainder of this Specification.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS

A. General fiber cable requirements:
   1. Suitable for the installed environment.
   2. Color-coded fibers according to TIA/EIA-598.
   3. Color-coded buffer tubes according to TIA/EIA-598.
   4. Furnish buffer tubes of a single layer nylon construction or of a material with similar mechanical performance.
   5. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.
   6. Apply binders with sufficient tension to secure buffer tubes to the central member without crushing the buffer tubes:
      a. Provide binders that are:
         1) Non-hygroscopic.
         2) Non-wicking (or rendered so by the flooding compound).
         3) Dielectric with low shrinkage.
   7. Provide a minimum of 1 ripcord under the cable sheath.
   8. Provide high tensile strength Aramid yarns, Kevlar, and/or fiberglass helically stranded evenly around the cable core:
      a. No metallic elements whatsoever are allowed in non-armored cable.
   9. Jacket or sheath shall be free of holes, splits, and blisters.
   10. Mark jacket or sheath with:
      a. Manufacturer’s name.
      b. “Optical Cable”.
      c. Year of manufacture.
      d. Sequential meter marks.
      e. Repeat markings every 1-meter.
      f. Actual length of the cable to be within 1 percent of the length marking.
      g. Marking must be in a contrasting color to the cable jacket.
      h. Height of the marking:
         1) Approximately 2.5 millimeters.
   11. Shipping, storage, and operating temperature range of the cable shall be -40 degrees Celsius to 70 degrees Celsius.
   12. General performance characteristics:
      a. Rated tensile load of the cables:
         1) Indoor/outdoor:
            a) Short term: 1,330 N.
            b) Long term: 400 N.
      b. Non-armored fiber optic cables: Compressive load withstand of 220 N/cm applied uniformly over the length of the cable.
      c. Armored fiber optic cables: Compressive load withstand of 440 N/cm applied uniformly over the length of the cable.

d. Average increase in attenuation for the fibers: Less than or equal to 0.10 dB at 1,550 nm for a cable subjected to this load:
    1) With no measurable increase in attenuation after load removal.
e. Test in accordance with EIA FOTP-41, except that the load must be applied at the rate of 3 millimeters to 20 millimeters per minute and maintained for 10 minutes.
f. Capable of withstanding 25 cycles of mechanical flexing at a rate of 30 within 1 cycles/minute.
g. Average increase in attenuation for the fibers: Less than or equal to 0.10 dB at 1,550 nm at the completion of the test.
h. For armored cables, any visible cracks causing separation of the armor and propagating more than 5 millimeters constitutes failure.
i. Outer cable jacket cracking or splitting observed under 10X times magnification, constitutes failure.

B. Indoor/outdoor cable:
1. Cable construction:
a. General:
1) Cable type: Indoor/Outdoor - Flame retardant, low smoke, zero halogen, UV resistant.
2) Fiber count: As indicated on the Drawings.
3) Fiber type: As indicated on the Drawings.
4) Buffer tube: Tight buffer
5) Armoring: None
6) Waterproofing: Water blocking layer.
7) Strength member:
a) Tight buffer: For cables with more than 12 fiber strands, utilize a central, nonmetallic strength member with a coefficient of thermal expansion similar to the fibers.
8) Approvals and listings: UL 1666 and UL 1685.
9) Design and test criteria: In accordance with ICEA S-104-696.
b. Testing:
1) Fibers in the cable:
a) Proof test of 100 kpsi.
b) Each optical fiber: Bellcore GR-409 strip force testing.
c) No gaps are allowed between the coating material and the buffer material visible under a 50-power microscope.
c. Outer jacket material:
1) Linear low-density polyethylene.
2) Meet requirements of the NEC for use in indoor/outdoor areas (excluding plenums) without being enclosed in conduit.
3) Flame retardant OFNR riser rated conforming to UL 1666.
4) Printed with necessary UL marks and manufacturer identification.
5) Sequential printing of footage in 2-foot increments.
6) With a ripcord incorporated under the cable jacket.

C. Single-mode fibers:
1. Fibers in the cable must be usable fibers and meet required specifications.
2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.

3. Single-mode fiber characteristics:
    a. Category: OS2 compliant with ITU-G.657.A1.

D. Indoor (tight buffer):
1. Corning Cable Systems, Freedm® One.
2. Optical Cable Corporation, DX-Series.

E. Indoor/outdoor:
1. Tight buffer:
    a. Corning Cable Systems, Freedm® One.
    b. Optical Cable Corporation, DX-Series.
    c. CommScope, LazrSPEED/TerraSPEED.

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES

A. Patch cords:
1. General:
    a. Connector types to match supplied equipment and patch panel terminations.
    b. Minimum length of patch cords: 6 feet.
    c. Provide 2 spare patch cords (or 1 duplex patch cord) of each type used at each PLC or network cabinet.
    d. Factory assembled and optically tested.
2. Manufacturers: One of the following or equal:
    a. CommScope.
    b. Corning Cable Systems.

B. Fiber connectors:
1. As specified in Section 17733 - Control Systems: Network Materials and Equipment.

C. Fiber optic identification/warning tags:
1. Black letters on orange or yellow background.
2. UV resistant polyethylene or other suitable material:
    a. Manufacturers: The following or equal:
        1) Almetek.

2.09 SOURCE QUALITY CONTROL

A. Source Testing:
1. Before shipment and while on the shipping reel, test 100 percent of fibers for attenuation:
    a. Copies of the results shall be:
        1) Maintained on file.
        2) Attached to the cable reel in a waterproof pouch.
        3) Submitted before the delivery of the cable to the jobsite to the Engineer for approval.

2. Conduct the flex test in accordance with EIA FOTP-104 test condition I and III with a maximum sheave diameter of 20 times the cable OD.
3. Verify that the cable withstands 25 impact cycles with:
    a. Average increase in attenuation for fibers less than 0.20 dB at 1,550 nm.
    b. No evidence of cracking or splitting.
    c. Conduct test in accordance with EIA FOTP-25.
4. Certify that the cable withstands a tensile load of 2,700 N (600 pounds):
    a. Without exhibiting an average increase in attenuation of greater than 0.10 dB.
    b. Test in accordance with EIA FOTP-33 using a maximum mandrel and sheave diameter of 560 millimeters.
    c. Apply the load for 1 hour in test condition II.
5. Certify that the cable withstands a simulated lightning strike:
    a. Peak value of the current pulse greater than 105 kA.
    b. Use a test current with a damped oscillatory maximum time-to-peak value of 15 µs (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz.
    c. Time to half-value of the waveform envelope 40 to 70 µs.
    d. Conduct the test in accordance with the EIA FOTP-181.
    e. In addition to the analysis criterion set forth in EIA FOTP-181, the integrity of the buffer tubes (or analogous loose tube, i.e., core tube) and strength members must be intact after removal of the cable specimens from the test box.
6. Furnish test reports.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify the condition of the conduit system before installation of the fiber optic cable or inner duct.

B. Pass a test mandrel through fiber optic conduits prior to pulling fiber or installing inner duct.
    1. Run the mandrel in both directions.

C. Examine materials and equipment before installation and verify they are free from physical damage and defects.

3.02 PREPARATION

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

B. Before fiber splicing terminating or testing activities, verify sufficient workspace is available to perform the activity without interferences from other trades.

C. Pre-installation test:
   1. Upon arrival at the Site:
      a. Inspect the cable and reel for damage.
      b. Test fibers with an optical time domain reflectometer (OTDR) for fiber integrity.
      c. Verify that the fiber lengths are consistent with the cable manufacture.
      d. Verify that traces yield no point discontinuities.
   2. Complete test sequence and obtain approval from the Engineer of submitted test results before cable installation.

3.03 INSTALLATION

A. Install fiber optic patch cords in open network trays or in dedicated conduits no longer than 25 feet in length.

B. Install fiber optic cable in continuous lengths without intermediate splices, except where approved by the Engineer.

C. Cable installation:
   1. Properly attach the fiber optic cable's strength elements to a 600-pound breakaway swivel containing tension or shear pins using Kellums pulling grips that are a minimum of 18 inches long.
   2. Certify that cable tensile limits do not exceed cable pull tension and bend limits using tension monitoring devices.
   3. Leave an extra loop of fiber optic cable in each pull box.
   4. Conform with the cable manufacturer's specifications, practices, and the following requirements:
      a. When power equipment is used to install fiber optic cables, use low speeds and do not exceed a rate of 30 meters per minute.
      b. Do not exceed the tensile and bending limitation for fiber optic cables under any circumstances.
      c. Use large diameter wheels, pulling sheaves, and cable guides to maintain the specified bending radius.
      d. Use commercial dynamometers or load cells to monitor pulling tension.
      e. A nonfreezing type of swivel inserted between the pulling line and cable pulling grip to prevent twisting under strain.
      f. Cable to be installed using a breakaway swivel.
   5. Apply to conduits a lubricant at each conduit ingress and egress location during the pull operation:
      a. Pour or pump lubricant into the end of the conduit at the feed location at a nominal application rate of 3 gallons per 1,000 feet of cable.
      b. If the conduit is open at intermediate locations, then apply the appropriate proportion of lubricant at each opening.
      c. Continuously lubricate the cable as it is being pulled by pouring or pumping the lubricant into the conduit at the feed location and at each intermediate location.
      d. Station workers at each intermediate location as required.
      e. Remove excess lubricant that has collected.
      f. Remove and clean the surrounding area after cable installation.

6. Install using a hydraulic capstan or winch equipped with a recording running line dynamometer graph which measures and records pulling tensions:
    a. Use pulling equipment with slip-load capability to allow the winch to maintain a constant pulling force without taking up the winch line.
    b. Use pulling equipment equipped with a hydraulic bypass set so that a maximum tension of 600 pounds is not exceeded.
    c. Use only equipment designed to prevent a preset pulling tension from being exceeded.
    d. Fiber optic cable manufacturer to provide the pulling tension setpoint.
    e. If during the pulling operation excessive tension is detected, cease operations and notify the Engineer.
7. Position the cable reel at the feed point in alignment with the raceway and in such a position that the cable can be passed from the top of the reel in a long, smooth bend into the raceway system:
    a. Use of a cable feeder is required unless the cable is hand-pulled.
8. Supply bull wheels, blocks, split wheels, cable feeders, and necessary equipment required to provide a clean and safe operation:
    a. Cable shall not be allowed to travel over any wheel or block that has a radius less than the minimum radius allowed by the cable manufacturer.
9. Minimize the use of snatch blocks and rollers to guide the cable into the conduit at the feed point:
    a. Slack feed by hand the cable into the feed point and raceway without the use of rollers.
10. Tend the cable reel at all times and turn by hand to provide the required cable slack:
    a. Under no circumstances shall the cable tension be allowed to turn the cable reel.
11. Use a rim roller, with a wheel radius greater than the minimum cable bending radius placed at the manhole or vault opening to prevent the cable from dragging on the manhole rim or steps.
12. Perform a continuous thorough visual inspection for flaws, breaks, and abrasions in the cable sheath as the cable leaves the reel and maintain a slow pulling speed to permit this inspection.
13. Damage to the sheath or finish of the cable is cause for rejecting the cable:
    a. Replace any cable damaged in any way during installation.
14. If the cable becomes damaged during installation, stop operations and notify the Engineer immediately:
    a. Engineer to determine whether to replace the entire reel of cable or to install a termination panel to eliminate the damaged section.
15. Document pulls by a graph which is annotated with the following information:
    a. Reel number.
    b. Pull point ID.
    c. Date and time.
    d. Explanations for abnormalities in readings or interruptions.
    e. Sign-off by the Contractor and Engineer.
16. Under no conditions shall the fiber optic cable be left exposed or unattended.

D. After the cables are installed and spliced:
    1. Rack the cables:
        a. Loosely secure in racked position with wire ties.

b. Attach imprinted plastic-coated cloth identification/warning tags to each cable in at least 2 locations in each handhole/manhole.

E. Splices:
1. Provide field splices in a splice tray located in a waterproof splice enclosure:
a. Manufacturers: The following or equal:
1) Tyco/Raychem, FOSC style splice enclosure.
2. Loop the individual fibers a minimum of 1 full turn within the splice tray to avoid macro/micro bending.
3. After completion of cable terminations, neatly dress cables.
4. Protect splices with a thermal shrink sleeve.
5. Provide fusion type fiber optic cable splicing meeting the following requirements:
a. Joins multimode or single-mode fibers.
b. Establishes a permanent fusion splice.
c. Waterproof.
d. Re-enterable, rearrangeable, and reusable.
e. Splice loss less than 0.10 dB.
f. Protected by a splice enclosure.
6. Requirement for outdoor fiber splice enclosures:
a. Seal.
b. Bond.
c. Anchor.
d. Protect fiber optic cable splices.
e. Stand-alone unit that does not require an outer enclosure.
f. Provide for a maximum of 6 cable entries in a butt-end configuration.
g. Used in aerial, underground, and direct buried applications.
7. Requirement for indoor fiber splice enclosures:
a. Anchor.
b. Protect fiber optic cable splices.
c. Stand-alone unit that does not require an outer enclosure.
d. Suitable for the minimum number of splices at that location plus additional capacity for reconfigurations.
8. Re-splice any splice that has a loss greater than 0.10 dB.
9. Leave a minimum of 20 feet of fiber optic cable at each end of splice.

F. Terminations:
1. Terminate fiber inside a patch panel:
a. Direct landing to a switch, router hub, or PLC will not be allowed.
2. Terminate outdoor cables using a breakout kit that seals the cable and provides physical protection for the fiber strands.
3. Terminate indoor cables using breakout kits with field installed terminators.
4. Labeling:
a. Permanently label cable terminations. Use labels produced by a wire printer using pressure sensitive polyester labels.
b. Label patch panels as specified in Section 16075 - Identification for Electrical Systems.

3.04 FIELD QUALITY CONTROL

A. Utilize personnel certified by the manufacturer with specific knowledge of the cable manufacturer’s recommended installation procedures.

B. General:
   1. Test results shall meet or exceed manufacturer specifications:
      a. Test each fiber of each cable for breaks, abnormalities, and overall attenuation characteristics.
   2. Pre-installation tests and post-installation tests to be witnessed and signed off by the Engineer and Owner.
   3. Perform OLTS test with equipment capable and calibrated to show anomalies of 0.1 dB as a minimum:
      a. Test multimode fibers at 850 nm and 1,300 nm.
      b. Test single-mode fibers at 1,310 nm and 1,550 nm.
   4. Perform OTDR tests on fiber cables less than 100 meters with the aid of a launch cable:
      a. Adjust OTDR pulse width settings to a maximum setting of 1/1,000th of the cable length or 10 nanoseconds.

3.05 OWNER TRAINING (NOT USED)

3.06 ADJUSTING (NOT USED)

3.07 CLEANING

A. Clean fiber optic connectors after termination and before testing. After cleaning, cover unterminated connectors with a protective boot.

B. At the completion of construction, touch up the finish on fiber patch panels and enclosures.

3.08 PROTECTION

A. Protect the fiber system from physical damage and the encroachment of dust, before, during, and after installation.

END OF SECTION

SECTION 16130

CONDUITS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Metallic conduits.
   2. Nonmetallic conduits.
   3. Conduit bodies.
   4. Conduit fittings and accessories.
   5. Conduit installation.

1.02 REFERENCES

A. Abbreviations:
   1. GRC: Galvanized rigid steel conduit.
   2. PCS: Polyvinyl chloride (PVC) coated rigid steel conduit.
   3. SLT: Sealtight-liquidtight flexible conduit.

B. Standards:
   1. National Electrical Manufacturers Association (NEMA):
   2. National Fire Protection Association (NFPA):
      a. 70 - National Electrical Code (NEC).
   3. Underwriters Laboratories (UL), Inc.:

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. Conduit bodies: A separate portion of a conduit system that provides access through a removable cover to the interior of the system at a junction of 2 or more conduit sections. Includes, but not limited to, shapes C, E, LB, T, X, etc.
   2. Conduit fitting: An accessory that primarily serves a mechanical purpose. Includes, but not limited to, bushings, locknuts, hubs, couplings, reducers, etc.

1.04 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures and Section 16070 - Hangers and Supports.

1.05 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Furnish complete manufacturer’s catalog sheets for every type and size of conduit, fitting, conduit body, and accessories to be used on the Project.

2. Furnish complete manufacturer's recommended special tools to be used for installation, if required.
3. Certified test results for PVC-coated metallic conduit showing the adhesive bond is stronger than the tensile strength of the PVC.

C. Delegated Design Submittals:
1. As specified in Section 16070 - Hangers and Supports.

D. Certifications:
1. Furnish PVC-coated conduit manufacturer's valid, unexpired certification for each installer.

1.06 QUALITY ASSURANCE

A. Conduits, conduit bodies, and fittings shall be UL listed and labeled.

B. Every installer of PVC-coated metallic conduit shall be certified by the manufacturer for installation of the conduit, and be able to present a valid, unexpired installer certification card prior to installation beginning.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not expose non-metallic conduit to direct sunlight.

B. Do not store conduit in direct contact with the ground.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide conduits, conduit bodies, fittings, junction boxes, and necessary components, whether or not indicated on the Drawings, as required, to install a complete electrical raceway system.

B. Provide location and protection of existing underground utilities, underground conduit trenching, conduit and backfill necessary for the complete installation of underground conduits.

2.03 MANUFACTURERS

A. Galvanized rigid steel conduit:
   1. One of the following or equal:
      a. Allied Tube and Conduit.
      b. Western Tube and Conduit.
      c. Wheatland Tube Co.

B. PVC-coated rigid steel conduit:
   1. One of the following or equal:
      a. Allied.
      b. Calbond.
      c. NEC, Inc. BlackGuard.
      d. Ocal, Inc.
      e. Robroy Ind.

C. Sealtight-liquidtight flexible conduit:
   1. One of the following or equal:
      a. AFC Cable Systems.
      b. Anaconda.
      c. Anamet.
      d. Calbrite.
      e. Electri-Flex Co.
      f. Gibson.
      g. Southwire.

D. Conduit bodies:
   1. One of the following or equal:
      a. Appleton.
      b. Calbond.
      c. Carlon.
      d. Crouse-Hinds.
      e. Gibson,
      f. O-Z/Gedney.
      g. Ocal, Inc.
      h. Robroy Ind.

E. Joint compound:
   1. As recommended by the conduit manufacturer.

F. Galvanized rigid steel conduit expansion fittings:
   1. One of the following or equal:
      a. Appleton.
      b. Crouse-Hinds.
      c. O-Z/Gedney.

G. PVC-coated rigid steel conduit expansion fittings:
   1. One of the following or equal:
      a. NEC, Inc. BlackGuard.
      b. Ocal, Inc.
      c. Robroy Ind.

H. Stainless steel conduit expansion fittings:
   1. The following or equal:
      a. Calbrite.

I. Conduit sleeve:
   1. One of the following or equal:
      a. Appleton.
      b. Crouse-Hinds.
      c. O-Z/Gedney.

2.04 MATERIALS

A. Provide conduit bodies, hubs, and other accessories consistent with the conduit type specified in the table below.

Conduit Type	Conduit Bodies and Covers	Fittings	Unions	Bushings and Hubs	Outlet Boxes
GRC	Malleable iron	Malleable iron	Malleable iron or zinc-plated steel	Malleable iron	Cast ferrous
PCS	PVC-coated malleable iron	PVC-coated malleable iron	PVC-coated steel	PVC-coated malleable iron	PVC-coated cast ferrous
IMC	Malleable iron	Malleable iron	Malleable iron or zinc-plated steel	Malleable iron	Cast ferrous
EMT	Malleable iron bodies with pressed steel covers or aluminum bodies with aluminum covers	Zinc-plated steel	N/A	Flexible plastic	Pressed metal
RAC	Cast aluminum	Aluminum	Aluminum	Aluminum	Aluminum (copper free)
PCA	PVC-coated copper-free cast aluminum	PVC-coated aluminum	PVC-coated aluminum	PVC-coated aluminum	PVC-coated aluminum
SSC	Type 316 stainless steel	Type 316 stainless steel	Type 316 stainless steel	Stainless steel	Stainless steel

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS

A. GRC:
   1. NPT standard conduit threads with a 3/4-inch taper per foot:
      a. Running conduit threads are not acceptable.
   2. Hot-dip galvanized inside and out:
      a. Ensures complete coverage and heats the zinc and steel to a temperature that ensures the zinc alloys with the steel over the entire surface.
      b. Electro-galvanizing is not acceptable.
   3. Manufactured in accordance with:
      a. UL 6.
      b. ANSI C80.1.

B. PCS:
   1. Steel conduit, before PVC coating, shall be new, unused, hot-dip galvanized material, in accordance with to the requirements for Type GRC.
   2. Coated conduit NEMA Standard RN-1:
      a. Galvanized coating may not be disturbed or reduced in thickness during the cleaning and preparatory process.
   3. Factory-bonded PVC jacket:
      a. Exterior galvanized surfaces shall be coated with primer before PVC coating to ensure a bond between the zinc substrate and the PVC coating.
      b. Nominal thickness of the exterior PVC coating shall be 0.040 inch, except where part configuration or application of the piece dictates otherwise.
      c. PVC coating on conduits and associated fittings shall have no sags, blisters, lumps, or other surface defects and shall be free of holes and holidays.
      d. PVC adhesive bond on conduits and fittings shall be greater than the tensile strength of the PVC plastic coating:
         1) Confirm bond with certified test results.
   4. Urethane coating shall be uniformly and consistently applied to the interior of conduits and fittings:
      a. Nominal thickness of 0.002 inch.
      b. Conduits having areas with thin or no coating are not acceptable.
      c. Threads shall be coated with urethane.
   5. PVC exterior and urethane interior coatings applied to the conduits shall afford sufficient flexibility to permit field bending without cracking or flaking at temperature above 30 degrees Fahrenheit (-1 degree Celsius).
   6. PCS conduit bodies and fittings:
      a. Malleable iron.
      b. Conduit body, before PVC coating, shall be new, unused material and shall be in accordance with appropriate UL standards.
      c. PVC coating on the outside of conduit bodies shall be 0.040 inch thick and have a series of ribs to protect the coating from tool damage during installation.
      d. 0.002-inch interior urethane coating.
      e. Utilize PVC coating as an integral part of the gasket design.
      f. Stainless steel cover screw heads shall be encapsulated with plastic to ensure corrosion protection.

g. PVC sleeve extending 1 conduit diameter or 2 inches, whichever is less, shall be formed at each female conduit opening.
    1) Inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used.
    2) Sleeve shall provide a vapor- and moisture resistant seal at every connection.
    3) Fittings shall be Form 8 and supplied with plastic encapsulated stainless steel cover screws. Fittings shall be UL Type 4X. Fittings shall be from the same manufacturer as the conduit in order to maintain system continuity and warranty.

C. SLT:
1. Temperature rated for use in the ambient temperature at the installed location but not less than the following:
    a. General purpose:
        1) Temperature range: -20 to 80 degrees Celsius.
    b. Oil-resistant:
        1) Temperature range: -20 to 60 degrees Celsius.
2. Sunlight-resistant, weatherproof, and watertight.

D. PVC:
1. Extruded from virgin PVC compound:
    a. Schedule 40 unless otherwise specified.
    b. Schedule 80 extra-heavy wall where specified.
2. Rated for 90 degrees Celsius conductors or cable.
3. Rated for use in direct sunlight.

E. Conduit bodies:
1. In accordance with Form 8, Mark 9, or Mogul design:
    a. Mogul design in accordance with NEC requirements for bending space for large conductors for conduit trade sizes of 1 inch and larger with conductors #4 AWG and larger, or where required for wire-bending space.
2. Gasketed covers attached to bodies with stainless steel screws secured to threaded holes in conduit body.

2.08 ACCESSORIES

A. Connectors and fittings:
1. Manufactured with compatible materials to the corresponding conduit.

B. Insulated throat metallic bushings:
1. Construction:
    a. Positive metallic conduit end stop.
    b. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
    c. Use fully insulated bushings on nonmetallic conduit system made of high-impact 150 degrees Celsius rated non-combustible thermosetting phenolic.

C. Insulated grounding bushings:
   1. Construction:
      a. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
      b. Tin-plated copper grounding saddle for use with copper or aluminum conductors.

D. Electrical unions:
   1. Construction:
      a. Concrete tight, 3-piece construction for rigid metallic conduit.
      b. 2-piece construction for PVC-coated conduit.
      c. Rated for Class I, Division 1, Group D in hazardous areas.

E. SLT fittings:
   1. Construction:
      a. Malleable iron.
      b. Stainless steel for use with SSC and stainless steel SLT.
      c. Furnished with locknut and sealing ring.
      d. Liquidtight, raintight, oiltight.
      e. Insulated throat.
      f. Furnish as straight, 45-degree elbows, and 90-degree elbows.
      g. Designed to prevent sleeving:
         1) Verify complete bonding of the raceway jacket to the plastic gasket seal.
      h. Equipped with grounding device to provide ground continuity irrespective of raceway core construction. Grounding device, if inserted into raceway and directly in contact with conductors, shall have rolled-over edges for sizes under 5 inches.
      i. Where terminated into a threadless opening using a threaded hub fitting, a suitable moisture-resistant/oil-resistant synthetic rubber gasket shall be provided between the outside of the box or enclosure and the fitting shoulder. Gasket shall be adequately protected by and permanently bonded to a metallic retainer.
   2. Corrosion-resistant and outdoor SLT fittings:
      a. Construction:
         1) PVC-coated liquidtight fittings with a bonded 0.040-inch-thick PVC coating on the metal connector to form a seal around the SLT conduit.
         2) Insulated throat and an integral sealing ring.

F. Hubs for threaded attachment of steel conduit to sheet metal enclosures:
   1. Construction:
      a. Insulated throat.
      b. PVC-coated when used in corrosive areas.
      c. Bonding locknut.
      d. Recessed neoprene O-ring to ensure watertight and dusttight connector.
      e. 1/2-inch through 1-1/4-inch steel zinc electroplated.
      f. 1-1/2-inch through 6-inch malleable iron zinc plated.
   2. Usage:
      a. Conduits in damp, wet, outdoor, and corrosive areas shall use threaded hubs for connections to sheet metal enclosures.

G. PVC fittings:
    1. Materials:
        a. Devices shall be made of PVC, using the same materials as used for Type PVC conduit.
        b. Metal hardware shall be stainless steel.

H. Expansion/deflection couplings:
    1. Use to compensate for movement in any directions between 2 conduit ends where they connect.
    2. Shall allow movement of 3/4 inch from the normal in all directions.
    3. Shall allow angular movement for a deflection of 30 degrees from normal in any direction.
    4. Constructed to maintain electrical continuity of the conduit system.
    5. Materials:
        a. End couplings: Bronze or galvanized ductile iron.
        b. Sleeve: Neoprene.
        c. Bands: Stainless steel.
        d. Bonding jumper: Tinned copper braid.

I. Expansion couplings:
    1. Shall allow for expansion and contraction of conduit:
        a. Permitting 8-inch movement, 4 inches in either direction.
    2. Constructed to maintain electrical continuity of the conduit system.

J. Conduit markers:
    1. As specified in Section 16075 - Identification for Electrical Systems.

PART 3 EXECUTION

3.01 EXAMINATION

A. Before installing any conduit or locating any device box:
    1. Examine the complete set of Drawings and Specifications, and applicable Shop Drawings.

B. Verify all dimensions and space requirements and make any minor adjustments to the conduit system as required to avoid conflicts with the building structure, other equipment, or the work of other trades.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. General:
    1. Conduit routing:
        a. Electrical drawings are diagrammatic in nature:
            1) Install conduit runs as specified with schematic representation indicated on the Drawings and as specified.

2) Modify conduit runs to suit field conditions, as accepted by the Engineer:
    a) Make changes in conduit locations that are consistent with the design intent but are dimensionally different, or routing to bypass obstructions.
    b) Make changes in conduit routing due to the relocation of equipment.
    c) Install conduits and equipment in such a manner as to avoid obstructions and to preserve headroom and keep openings and passageways clear.
3) Where the Drawings do not indicate the exact mounting and/or supporting method to be used, use materials and methods similar to the mounting details indicated on the Drawings.
4) Electrical drawings do not indicate all required junction boxes and pull boxes:
    a) Provide junction boxes and pull boxes to facilitate wire pulling as required:
        (1) To meet cable manufacturer's pulling tension requirements.
        (2) To limit total conduit bends between pull locations.
    b) Install junction boxes and pull boxes at locations acceptable to the Engineer.

b. Contractor is responsible for any deviations in general location, conduit size, routing, or changes to the conduit schedule without the express written approval or direction by the Engineer:
    1) Engineer is the sole source in determining whether the change is constituted as a deviation.
    2) Perform any changes resulting in additional conduits, or extra work from such deviations.
    3) Incorporate any deviations on the Record Documents.

2. Use only tools recommended by the conduit manufacturer for assembling the conduit system.
3. Provide adequate clearances from high-temperature surfaces for conduit runs. Provide minimum clearances as follows:
    a. Clearance of 6 inches from surfaces 113 to 149 degrees Fahrenheit.
    b. Clearance of 12 inches from surfaces greater than 149 degrees Fahrenheit.
    c. Keep conduits at least 6 inches from the coverings on hot water and steam pipes, 18 inches from the coverings on flues and breechings, and 12 inches from fuel lines and gas lines.
    d. Where it is necessary to route conduits close to high-temperature surfaces, provide a high-reflectance thermal barrier between the conduit and the surface.
4. Support conduit runs on water-bearing walls a minimum of 7/8 inch away from the wall on an accepted preformed channel:
    a. Do not run conduits within water-bearing walls unless otherwise indicated on the Drawings.
5. Do not install 1-inch or larger conduits in or through structural members unless approved by the Engineer.

6. Run conduits exposed to view parallel with or at right angles to structural members, walls, or lines of the building:
    a. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends.
    b. Make changes in direction with long radius bends or with conduit bodies.
7. Install conduits with total conduit bends between pull locations less than or equal to 270 degrees.
8. Route exposed conduits to preserve headroom, access space and workspace, and to prevent tripping hazards and clearance problems:
    a. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and do not block or interfere with ingress or egress, including equipment-removal hatches.
    b. Route conduits to avoid drains or other gravity lines. Where conflicts occur, relocate the conduit as required.
9. When installing conduits through existing slabs or walls, make provisions for locating any possible conflicting items where the conduit is to penetrate. Use tone signal or X-ray methods to make certain that no penetrations will be made into the existing conduits, piping, cables, post-tensioning cables, etc.
10. Plug conduits brought into pull boxes, manholes, handholes, and other openings until used to prevent entrance of moisture.
11. Install conduits through wall and floor seals where indicated on the Drawings.
12. For new and existing underground and embedded conduits 1 inch and larger, snake conduits with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of the conduit.
13. Provide sleeves and openings required for the passage of electrical raceways or cables even when these openings or sleeves are not specifically indicated on the Drawings.
14. Install complete conduit systems before conductors are installed.
15. Provide metallic conduits terminating in transformer, switchgear, motor control center, or other equipment conduit windows with grounding bushings and ground with a minimum No. 6 AWG ground wire.

B. Equipment grounding conductors:
    1. Provide a separate, green insulated, grounding conductor in each raceway independent of raceway material:
        a. Multi-conductor power and control cables shall include an integral green insulated grounding conductor.
        b. Provide a separate grounding conductor in each individual raceway for parallel feeders.
    2. Conductors shall be the same type and insulation as the circuit conductors:
        a. Use 600-volt insulation for the equipment grounding conductors for medium voltage systems.
    3. Minimum size in accordance with the NEC.

C. Conduit usage:
    1. Exposed conduits:
        a. Rigid conduit:
            1) Install the rigid conduit type for each location as specified in Section 16050 - Common Work Results for Electrical.
            2) Minimum size: 3/4 inch.

b. Flexible conduit:
    1) Use flexible conduit for final connections between rigid conduit and motors, vibrating equipment, instruments, control equipment, or where required for equipment servicing:
        a) Use Type SLT with rigid metallic conduit.
    2) Minimum size: 3/4 inch:
        a) 1/2 when required for connection to instruments.
    3) Maximum length:
        a) Fixed equipment:

Conduit Trade Size	Flexible Conduit Length (inch)
3/4	18
1	18
1-1/4	18
1-1/2	18
2	36
2-1/2	36
3	36
3-1/2	38
4	40

        b) Removable instruments or hinged equipment:
            (1) As required to allow complete removal or full movement without disconnecting or stressing the conduit.

2. Concrete-encased and embedded conduits:
    a. Straight runs and bends less than 45 degrees:
        1) Type PVC Schedule 40.
    b. Bends with total deflection greater than 45 degrees;
        1) PCS.
    c. Entering and exiting duct bank, underground or embedded conduit runs a minimum 12 inches above and below grade, finished floor, or entering equipment:
        1) PCS.
    d. Minimum size:
        1) 2 inches in duct banks.
        2) 1 inch for in-slab conduits.
        3) Provide conduit fittings to enlarge the conduit from the exposed size in the conduit schedule as required.
3. GRC:
    a. Conduit shall be cut square and reamed before threading.
4. Exposed PVC:
    a. Conduit terminations shall be via threaded adapters into threaded hubs on the junction boxes or conduit bodies.
    b. Conduit terminations into boxes without threaded hubs shall utilize a threaded adapter and a flat neoprene washer on the outside of the box.
        1) Use a locknut on the inside of the box to tighten the adapter to the box.

c. Route conduit to afford it the maximum physical protection.
    1) If necessary, cover conduit to afford additional protection when it cannot be shielded by the structure or machinery frames.
        a) Use Schedule 80 where exposed runs may be subject to physical damage.

D. Conduit joints and bends:
    1. General:
        a. Where conduit is underground, under slabs on grade, exposed to the weather, or in NEMA Type 4 or NEMA Type 4X locations, make joints liquidtight.
        b. Keep bends and offsets in conduit runs to an absolute minimum.
        c. Bends shall be symmetrical.
        d. The following conduit systems shall use large-radius sweep elbows:
            1) Underground conduits.
            2) Conduits containing fiber optic cables.
        e. Provide factory-made elbows for large-radius bends for conduits 1-1/4-inch trade size or larger.
        f. Make field bends with a radius of not less than the requirements found in the NEC:
            1) Minimum bending radius of the cable must be less than the radius of the conduit bend.
            2) Make field bends with power bending equipment or manual benders specifically intended for the purpose:
                a) Make bends so that the conduit is not damaged and the internal diameter is not effectively reduced.
                b) For the serving utilities, make bends to meet their requirements.
            3) For PCS conduit, field bends are permitted on conduits 1 inch and smaller. Manufactured elbows shall be used on conduits larger than 1 inch.
        g. Replace deformed, flattened, or kinked conduit.
    2. Threaded conduit:
        a. Cut threads on rigid metallic conduit with a standard conduit-cutting die that provides a 3/4-inch per foot taper and to a length such that bare metal exposed by the threading operation is completely covered by the couplings or fittings used. In addition, cut the lengths of the thread such that joints become secure and wrench-tight just preceding the point where the conduit ends would butt together in couplings or where conduit ends would butt into the ends or shoulders of other fittings.
        b. Thoroughly ream conduit after threads have been cut to remove burrs.
        c. Use bushings or conduit fittings at conduit terminations.
        d. On exposed conduits, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing Galvabar™, or CRC Zinc It.
        e. Coat conduit threads with an approved electrically conductive sealant and corrosion inhibitor that is not harmful to the conductor insulation:
            1) Apply to the male threads and tighten joints securely.
            2) Clean excess sealant from exposed threads after assembly.
        f. Securely tighten threaded connections.
        g. Any exposed threaded surfaces must be cleaned and coated with a galvanizing solution so that exposed surfaces have a galvanized protective coating.

3. PVC:
    a. Use approved solvent-weld cement specifically manufactured for the purpose. Spray-type cement is not allowed.
    b. Apply heat for bends so that conduit does not distort or discolor. Use a spring mandrel as required to ensure full inside diameter at bends:
        1) Utilize a heater specifically for PVC conduit as recommended by the conduit manufacturer.

E. Conduit sealing and drainage:
1. Other than required for hazardous and classified areas:
    a. Provide sealing and drainage in vertical drops of long (in excess of 20 feet), exterior, above-grade conduit runs at the points at which the conduit enters buildings, switchgear, control panels, lighting panelboards, and other similar enclosures.
    b. Provide seal fittings with drains in vertical drops directly above grade for exterior and above-grade conduit runs that are extended below grade.
    c. Provide conduit seals with drains in areas of high humidity and rapidly changing temperatures:
        1) Where portions of an interior raceway pass through walls, ceilings, or floors that separate adjacent areas having widely different temperatures.
    d. Provide conduit seals similar to O-Z/Gedney (Type CSM) on conduits between corrosive and non-corrosive areas.
    e. Seal one end only of underground conduits at highest point with O-Z/Gedney sealing (non-hazardous) filling, or equal.
2. Install seals with drains at any location along conduit runs where moisture may condense or accumulate. This requirement includes, but is not limited to, the following locations: Control panels, junction boxes, pullboxes, or low points of the conduit.

F. Hangers and supports:
1. General:
    a. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications:
        1) As specified in Section 16070 - Hangers and Supports.
        2) Provide support materials consistent with the type of conduit being installed as specified in Section 16050 - Common Work Results for Electrical.
    b. Support conduit at the intervals required by the NEC.
    c. Perforated strap and plumbers' tape are not acceptable for conduit supports.
2. Finished areas:
    a. Above suspended ceilings:
        1) Support conduit on or from the structure. Do not support conduit from hanging wires or suspended ceiling grid.
    b. Concealed conduit on wood:
        1) Use 2-hole galvanized steel straps screwed or nailed to the wood or hammer-driven stamped galvanized-type supports having serrated or sawtooth edges on the driven portion and designed specifically for the size and type of conduit being supported. Drive these latter supports

so that the conduit is tightly and rigidly supported. Replace any dented or damaged conduit.

c. In steel-stud construction:
   1) Tie conduit at maximum 4-foot intervals with No. 16 gauge double-annealed galvanized wire or conduit clips so that conduit cannot move from vibration or other causes.

3. Conduit on concrete or masonry:
   a. Use 1-hole malleable iron straps with metallic or plastic expansion anchors and screws or support from preset inserts.
   b. Use preset inserts in concrete when possible.
   c. Use pipe spacers (clamp backs) in wet locations.
4. Suspended conduit:
   a. Use malleable-iron factory-made split-hinged pipe rings with threaded suspension rods sized for the weight to be carried (minimum 3/8-inch diameter), Kindorf, or equal.
   b. For grouped conduits, construct racks with threaded rods and tiered angle iron or preformed channel cross members. Clamp each conduit individually to a cross member. Where rods are more than 2 feet long, provide rigid sway bracing.
5. Supports at structural steel members:
   a. Use beam clamps.
   b. Drilling or welding may be used only as specified or with approval of the Engineer.
6. Exposed PVC conduit supports:
   a. Mount conduits with hangers specifically designed for use with PVC to minimize the problems of bowing resulting from the expansion and contraction of conduits caused by varying temperatures:
      1) Hangers to be constructed of PVC incorporating serrated teeth to grip the conduit securely and yet allow for conduit movement due to thermal considerations.
      2) Manufacturers: The following or equal:
         a) Carlon; Models E978D, E, F, G, H, and J.

G. Expansion or expansion/deflection fittings:
   1. General:
      a. Align expansion coupling with the conduit run to prevent binding.
      b. Follow manufacturer's instructions to set the piston opening.
      c. Install expansion fittings across concrete expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction.
      d. Furnish fittings of the same material as the conduit system.
   2. For metallic conduit, provide expansion or expansion/deflection couplings, as appropriate, where:
      a. Install expansion fittings a minimum of every 200 feet in straight conduit runs.
   3. For exposed PVC, provide expansion or expansion/deflection couplings, as appropriate, where length change due to temperature variation exceeds 2 inches:
      a. Rigidly fix the outer barrel of the expansion coupling so it cannot move.
      b. Mount the conduit connected to the piston loosely enough to allow the conduit to move as the temperature changes.

H. Empty conduits:
   1. Provide a pull tape in each empty conduit more than 10 feet in length.
   2. Seal ends of conduits with approved, manufactured conduit seals, caps, or plugs immediately after installation:
      a. Keep ends sealed until immediately before pulling conductors.

I. Miscellaneous:
   1. Provide electrical unions at all points of union between ends of rigid conduit systems that cannot otherwise be coupled:
      a. Running threads and threadless couplings are not allowed.
   2. Replace any conduits installed that the Engineer determines do not meet the requirements of this Specification.
   3. Provide conduit housekeeping curb around embedded or below-grade conduits exiting or entering the slab, in accordance with the Typical Details.

END OF SECTION

SECTION 16134

BOXES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Device boxes.
   2. Raceway system boxes.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

B. Joint Industry Conference (JIC).

C. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

D. National Fire Protection Association (NFPA):
   1. 70 - National Electrical Code (NEC).

E. Underwriters Laboratories, Inc. (UL):
   1. 514A - Metallic Outlet Boxes.

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. Arcing parts: Circuit breakers, motor controllers, switches, fuses, or any device intended to interrupt current during its operation.
   2. Raceway system boxes: Boxes that are used for wire and cable pullboxes, conduit junction boxes, or terminal boxes.

1.04 DELEGATED DESIGN (NOT USED)

1.05 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Manufacturer.
   2. Materials.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.

d. Weight.
e. NEMA rating.
4. Conduit entry locations.
5. Catalog cutsheets.
6. Installation instructions.

C. Shop Drawings:
1. Include identification and sizes of pullboxes.

1.06 QUALITY ASSURANCE

A. Regulatory requirements:
1. Outlet boxes shall comply with applicable standards of:
a. JIC.
b. NEC.
c. NEMA.
d. UL.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide outlet boxes for wiring devices, junction, and pullboxes for use in the raceway systems, etc.

B. Provide boxes as indicated on the Drawings and as needed to complete the raceway installation.

C. Size pullboxes in accordance with NEC requirements and to provide sufficient room for any future conduits, components, and cables as indicated on the Drawings.

D. Provide materials and construction suitable for environmental conditions at the location of the box as specified in Section 16050 - Common Work Results for Electrical.

E. For boxes not indicated:
   1. Provide outlet boxes to match the exposed conduit system. Provide junction boxes and pull boxes as specified in Section 16050 - Common Work Results for Electrical.

2.03 MANUFACTURERS

A. One of the following or equal:
   1. Plastic and/or fiberglass boxes:
      a. Carlon.
      b. Hoffman.
      c. Stahlin.
   2. Plastic coated boxes:
      a. OCAL.
      b. Rob Roy.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS

A. Plastic coated cast device boxes:
   1. Construction:
      a. With internal green ground screw.
      b. Furnished with a suitable gasketed cover.
      c. With integral cast mounting lugs when surface mounted.
      d. Conduit sizes range from 3/4 inch to 1 inch.
      e. Double coated with a nominal 0.002-inch (2 mil) urethane on both the interior and exterior before application of PVC coating.
      f. With a minimum 0.040-inch (40 mil) PVC coating bonded to exterior.
      g. With pressure sealing sleeve to protect the connection with conduit.

B. Fiberglass boxes:
   1. NEMA Type 4X.
   2. Constructed of molded fiberglass reinforced polyester.
   3. Integral neoprene gasket on cover attached with an oil-resistant adhesive.
   4. Enclosures to have internal pads for mounting optional panels and terminal kits.
   5. Covers:
      a. Screw cover enclosures:
         1) Covers held in place with captive, stainless steel, or Monel® screws.
         2) Covers attached to body with internal zinc-plated steel hinges.
      b. Quick release latches covers:
         1) Corrosion resistant fiberglass hinges.
         2) Spring loaded fiberglass latches with a Monel® or stainless steel bail attached with Monel® or stainless steel screws.
         3) With a Type 316 stainless steel padlock hasp.
   6. With external mounting feet.

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES

A. Fasteners:
   1. Electroplated or stainless steel in boxes with wiring devices.
   2. Screws, nuts, bolts, and other threaded fasteners:
      a. Stainless steel.

B. Provide breather and drain fittings where appropriate.

C. Internal panels:
   1. Provide internal panels where required for mounting of terminal strips or other equipment.
   2. With plated steel shoulder studs.
   3. Steel with white polyester powder finish.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. General:
   1. Provide outlet box materials to match the exposed conduit system as specified in Section 16130 - Conduits.
   2. Solid type gang boxes:
      a. For more than 2 wiring devices.
      b. For barriered outlets.
   3. Support wall mounted NEMA Type 4 or NEMA Type 4X boxes to maintain a minimum of 7/8-inch free air space between the back of the enclosure and the wall:
      a. Use machined spacers to maintain air space; built-up washers are not acceptable.
      b. Use stainless steel or nylon materials for spacers.
   4. Use cast boxes when box must support other devices.
   5. Boxes serving luminaires or wiring devices:
      a. Use as pullboxes wherever possible.
   6. In finished areas:
      a. Provide specific pull or junction boxes only as indicated on the Drawings or as directed.
   7. In terminal boxes, furnish terminals as indicated on the Drawings with a minimum of 50 percent spare terminals:
      a. Furnish wireways for discrete and analog/DC wiring.
      b. Separate analog wiring from 120 V discrete or power wiring.
   8. For fire-rated construction, provide materials and installation for use in accordance with the listing requirements of the classified construction.

B. Outlet boxes:
   1. Locate outlet boxes as indicated on the Drawings:
      a. Adjust locations so as not to conflict with structural requirements or other trades.
   2. Use deep threaded-hub cast boxes:
      a. In hazardous areas.
      b. Where exposed to the weather.
      c. In unheated areas.
      d. Where subject to mechanical damage:
         1) Defined as exposed boxes less than 10 feet above the floor.
      e. To act as a pullbox for conductors in a conduit system.
   3. Outlet boxes may be used as junction boxes wherever possible.

C. Pullboxes and junction boxes:
   1. Provide junction box materials and NEMA ratings as specified in Section 16050 - Common Work Results for Electrical.
   2. Install pullboxes such that access to them is not restricted.
      a. Non-fire rated construction:
         1) Depth: To suit job conditions and comply with the NEC.
         2) For luminaries: Use outlet boxes designed for the purpose:
            a) 50 pounds or less: Box marked “For Fixture Support.”
            b) More than 50 pounds: Box listed and marked with the weight of the fixture to be supported (or support luminaire independent of the box).
         3) For ceiling suspended fans:
            a) 35 pounds or less: Marked “Acceptable for Fan Support.”
            b) More than 35 pounds, up to 70 pounds: Marked “Acceptable for Fan Support up to 70 pounds (or support fan independent of the box).”
         4) For junction and pullboxes: Use galvanized steel boxes with flush covers.
         5) For switches, receptacles, etc.:
            a) Plaster or cast-in-place concrete walls: Use 4-inch or 4-11/16-inch galvanized steel boxes with device covers.
            b) Walls other than plaster or cast-in-place concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.
   3. Fire rated construction: Use materials and methods to comply with the listing requirements for the classified construction.

D. Recessed boxes:
   1. Support recessed boxes in suspended ceilings or stud partitions with galvanized steel box hangers of types made specifically for the purpose or attach directly to wood members or blocking.
   2. Secure hangers or boxes to wood with 1-inch-long cadmium-plated Type A pan head screws:
      a. Fully or partially hammer-driven screws are not acceptable.

END OF SECTION

SECTION 16150

LOW VOLTAGE WIRE CONNECTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Wire connecting devices.
   2. Terminations.
   3. Splices.
   4. Power distribution blocks.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.

B. CSA International (CSA):
   1. C22.2 - No. 197-M1983 (R2208) - PVC Insulating Tape.

C. Underwriters Laboratories, Inc. (UL):
   1. 486A-B - Standard of Safety for Wire Connectors.
   2. 510 - Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
   3. 1953 - Outline of Investigation for Power Distribution Blocks.

1.03 DELEGATED DESIGN (NOT USED)

1.04 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Catalog cutsheets.
   2. Installation instructions.

1.05 QUALITY ASSURANCE

A. Materials shall be UL listed.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide a complete system of wiring connectors, terminators, fittings, etc., for a complete wiring system suitable for the cables and conductors used.

2.03 MANUFACTURERS

A. Manufacturers for each type of technology are specified with the equipment in this Section.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

A. Control connections:
   1. Use insulated ring type wire terminators for connections to screw terminals:
      a. With chamfered/funneled terminal barrel entry.
      b. Deep internal serrations.
      c. Long barrel design to reduce electrical resistance and increased insulator-barrel surface area to ensure that the insulator remains in contact with the barrel.
      d. Electroplated-tin copper conductor.
      e. Manufacturers: The following or equal:
         1) ABB, Sta-Kon.
   2. For process equipment connections, work from the manufacturer’s drawings.

B. Joints, splices, taps, connections, and terminations:
   1. 600-volt conductors:
      a. Use solderless connectors.
      b. Copper pigtail adaptors.
         1) For use on select applications as approved by the Engineer.
         2) 600 volt, 90 degrees Celsius rated.
         3) UL 486A/B listed.
         4) Manufacturers: One of the following or equal:
            a) Burndy APY series.
            b) ILSCO CPM series.
      c. Use only plated copper alloy connectors or lugs:
         1) Aluminum connectors or lugs are not acceptable for copper conductors.

d. Under those specific conditions where aluminum conductors have been allowed or are specified then the connectors for aluminum conductors shall be specifically designed for that purpose.
e. For wire #10 AWG and smaller, use compression splice caps, with insulating caps:
    1) Manufacturers: The following or equal:
        a) Buchanan, 2006S or 2011S, with 2007 or 2014 insulating caps.
f. For wire #8 AWG and larger, use heavy duty copper compression connectors:
    1) Manufacturers: One of the following or equal:
        a) ABB.
        b) Burndy.
g. Heat shrink tubing:
    1) Suitable for indoors, outdoors, overhead, direct burial or submerged applications.
    2) Minimum shrink ratio: 4 to 1.
    3) Continuous operating temperature: -55 degrees Celsius to 110 degrees Celsius.
    4) Internally applied adhesive sealant.
    5) Cross-linked polyolefin:
        a) Manufacturers: One of the following or equal:
            (1) 3M, ITCSN.
            (2) ABB, Shrink-Kon.

2. Instrumentation class cable splices:
    a. Suitable for indoor, outdoors, weather exposed, direct buried, or submersed applications.
    b. Utilizing an epoxy, polyurethane, and re-enterable compounds.
    c. For use with shielded or unshielded plastic- and rubber-jacketed, signal, control, and power cables rated up to 1 kilovolt.
    d. Two-part mold body with tongue and groove seams and built-in spacer webbing.
    e. Manufacturers: The following or equal:
        1) 3M, Scotchcast 72-N.

C. Insulating tape:
1. General purpose insulating tape:
    a. Minimum 7 mil vinyl tape.
    b. Suitable for application in an ambient of -18 degrees Celsius (0 degrees Fahrenheit).
    c. Operating range up to 105 degrees Celsius (220 degrees Fahrenheit).
    d. Flame retardant, hot- and cold-weather resistant, UV resistant.
    e. For use as a primary insulation for wire cable splices up to 600 VAC.
    f. Meeting and complying with:
        1) ASTM D3005, Type I.
        2) UL 510.
        3) CSA C22.2.
    g. Manufacturers: The following or equal:
        1) 3M, Scotch Number Super 33+.
2. General purpose color-coding tape:
    a. Minimum 7 mil vinyl tape.
    b. Suitable for application on PVC and polyethylene jacketed cables.

c. For use indoors and outdoors in weather protected enclosures.
d. Available with the following colors:
    1) Red.
    2) Yellow.
    3) Blue.
    4) Brown.
    5) Gray.
    6) White.
    7) Green.
    8) Orange.
    9) Violet.
e. For use as phase identification, marking, insulating, and harnessing.
f. Meeting and complying with:
    1) UL 510.
    2) CSA C22.2.
g. Manufacturers: The following or equal:
    1) 3M, Scotch Number 35.

D. Power distribution blocks:
1. UL 1953 listed.
2. Short circuit rating: Not less than the system maximum available fault current at the point of application.
3. Provide fuses or circuit breakers in enclosure as required to meet the fault current requirements.
4. Voltage rating: 600 VAC.
5. IP 20 finger safe enclosure.
6. Tin-plated aluminum or copper terminals suitable for copper conductors.
7. Manufacturers: One of the following or equal:
    a. Eaton CHDB series.
    b. Rockwell Automation 1492 PD series.
    c. Schneider Electric LB series.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Load connections:
1. Connect loads to the circuits as indicated. Color-code branch circuits as specified in Section 16123 - 600-Volt or Less Wires and Cables.

B. Zero to 600-volt systems:
1. Make connections with the proper tool and die as specified by the device manufacturer.
2. Use only tooling and dies manufactured by the device manufacturer.
3. Insulate connections and splices with Scotch 33+ tape and Scotchfill, or pre-molded plastic covers, or heat shrink tubing and caps.

4. Number power and control wires before termination.

C. Motor connections (600 volts and below):
   1. Terminations on motor leads, including leads that are connected to accommodate the motor current, and the wires entering the motor terminal box from the power source, shall have ring type compression lugs or mechanical torqued insulated lugs.
   2. Cover bolted connectors with a heat shrinkable, cross-linked polyolefin material formed as a single opening boot:
      a. In damp and wet locations, use a complete kit containing mastic that shall seal out moisture and contamination.
      b. Shrink cap with low heat as recommended by the manufacturer.
   3. Wire markers shall be readable after boot installation.
   4. Manufacturers: One of the following or equal:
      a. ABB, Blackburn Insulated multi-taps connectors.
      b. NSI Industries, Polaris insul-tap connectors.
      c. Raychem, MCK.

D. Power distribution terminal blocks:
   1. Connect fuses or circuit breakers on the line side of power distribution terminal blocks as required to meet short circuit requirements.

END OF SECTION

SECTION 16950

FIELD ELECTRICAL ACCEPTANCE TESTS

TABLE OF CONTENTS

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. American National Standards Institute (ANSI).
   2. ASTM International (ASTM):
      a. D877 - Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes.
      b. D923 - Standard Practices for Sampling Electrical Insulating Liquids.
      c. D924 - Standard Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids.
      d. D971 - Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.
      e. D974 - Standard Test Method for Acid and Base Number by Color-Indicator Titration.
      f. D1500 - Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
      g. D1524 - Standard Test Method for Visual Examination of Used Electrical Insulating Liquids in the Field.
      h. D1533 - Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
      i. D1816 - Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes.
      j. D3612 - Standard Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography.
   3. 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. 450 - IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.

e. 1106 - IEEE Recommended Practice for Installation, Maintenance, Testing, and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications.
f. 1188 - IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications.
g. C57.13 - IEEE Standard Requirements for Instrument Transformers.
h. C57.13.1 - IEEE Guide for Field Testing of Relaying Current Transformers.
i. C57.13.3 - IEEE Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.
j. C57.104 - IEEE Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers.

4. Insulated Cable Engineer's Association (ICEA).
5. InterNational Electrical Testing Association (NETA).
   a. ATS- Standard for Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
6. International Electrotechnical Commission (IEC).
7. National Electrical Manufacturers Association (NEMA):
   a. MG1 - Motors and Generators.
8. National Fire Protection Association (NFPA):
   a. 70 - National Electrical Code (NEC).
   b. 110 - Standard for Emergency and Standby Power Systems.
9. 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 01330 - 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 01850 - 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 01783 - 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.

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. 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. Functional Testing:
1. Also called Field Acceptance Testing.

B. 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 Engineer.

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 anti-pump 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 higher:
      1) Perform electrical tests as specified in this Section.

C. 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.

D. 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 breakers 100 A and higher:
        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. 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:
            a) 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) Perform minimum pickup voltage tests on shunt trip and close coils in accordance with the manufacturer's published data.
9) 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.
10) 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. Microhm 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.

E. 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 5 ohms or less.
        e. Investigate point-to-point resistance values that exceed 0.5 ohm.

F. 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. Motor protection parameters shall be in accordance with the manufacturer's published data.
    e. Circuit breaker test results shall as be specified in this Section.
    f. Control devices shall perform in accordance with system design requirements.

G. 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 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.
f. 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.
g. Verify operation of space heaters.
h. 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. Instrument transformer test values shall be as specified in this Section.

f. Investigate grounding system point-to-point resistance values that exceed 0.5 ohm.
g. Meter accuracy shall be in accordance with the manufacturer's published data.
h. 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.
i. Heaters shall be operational.
j. Test values for motor control center components shall be as specified in this Section.

H. 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 insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with switch in both source positions and across each open pole. Test voltage 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. Perform a contact/pole-resistance test.
d. Verify settings and operation of control devices.

e. Calibrate and set relays and timers as specified in this Section.
f. Verify phase rotation, phasing, and synchronized operation as required by the application.
g. 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.
h. 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. Microhm 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.
    e. Control devices shall operate in accordance with the manufacturer's published data.
    f. Relay test results shall be as specified in this Section.
    g. Phase rotation, phasing, and synchronization shall be as specified in the system design specifications.
    h. Operation and timing shall be in accordance with the manufacturer's and system design requirements.

I. 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.

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 17050

COMMON WORK RESULTS FOR PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Process control and instrumentation systems requirements for common components including installation, including, but not limited to, the following:
      a. Hardware.
      b. Software.
      c. Programming.
      d. Testing.
      e. Commissioning.
   2. Loop drawings:
      a. Provide complete loop drawings for all systems, including packaged equipment furnished as part of a vendor furnished package, and pre-purchased equipment.
      b. The form, minimum level of detail, and format for the loop drawings must match that of the sample loop drawings included in the Contract Documents.
      c. Owner and Engineer are not responsible for providing detailed loop diagrams for Contractor-furnished equipment.
   3. Requirements of the Instrumentation and Control Specifications apply to all Instrumentation and Control Work specified in Technical Sections, including packaged mechanical systems, local control panels (LCPs), vendor control panels (VCPs), etc.
   4. As specified in this Section, some PLC programming and SCADA/HMI software configuration will be provided by the Owner, hereinafter referred to as the programmer.

B. Contract Drawings:
   1. Schematic diagrams:
      a. Use schematic diagrams in conjunction with the descriptive operating sequence in the Technical Sections to furnish a coordinated and fully functional control system.
      b. Schematic diagrams show control function only.
         1) Incorporate other necessary functions for proper operation and protection of the system.
      c. Controls are indicated on the Drawings as de-energized.
      d. 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.

1.02 REFERENCES

A. Abbreviations:
   1. ACB: Automatic current balance.
   2. ATS: Automatic transfer switch.
   3. CCS: The PCS central computer system (CCS) consisting of computers and software. The personal computer-based hardware and software system that includes the operator interface, data storage, data retrieval, archiving, alarming, historian, reports, trending, and other higher level control system software and functions.
   4. DPDT: Double-pole, double-throw.
   5. ECP: Electronic circuit protector.
   6. ES: Ethernet switch.
   7. FAT: Factory acceptance test, also known as Source Test.
   8. HART: Highway addressable remote transducer.
   9. HMI: Human machine interface is a software application that presents information to an operator or user about the state of a process, and to accept and implement the operators control instructions. Typically, information is displayed in a graphical format.
   10. HOA: Hand-Off-Auto control function that is totally PLC based. In the Hand mode, equipment is started or stopped, valves are opened or closed through operator direction under the control of the PLC software. In the Auto mode, equipment is started or stopped, and valves are opened or closed through a control algorithm within the PLC software. In the Off mode, the equipment is prohibited from responding from the PLC control.
   11. I/O: Input/Output.
   12. ICSC: Instrumentation and control system contractor: Subcontractor who specializes in the design, construction, fabrication, software development, installation, testing, and commissioning of industrial instrumentation and control systems.
   13. IJB: Instrument junction boxes: A panel designed with cord sets to easily remove, replace, or relocate instrument signals.
   14. IP: Internet protocol or ingress protection.
   15. LAN: Local area network: A control or communications network that is limited to the physical boundaries of the facility.
   16. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
   17. LOI: Local Operator Interface is an operator interface device consisting of an alphanumeric or graphic display with operator input functionality. The LOI is typically a flat panel type of display mounted on the front of an enclosure with either a touch screen or tactile button interface.
   18. LOR: Local-Off-Remote control function. In the Remote mode, equipment is started or stopped, and valves are opened or closed through the PLC based upon the selection of the HOA. In the Local mode, equipment is started or stopped, valves are opened or closed based upon hardwired control circuits completely independent of the PLC with minimum interlocks and permissive conditions. In the Off mode, the equipment is prohibited from responding to any control commands.

19. NJB: Network junction box. An enclosure that contains multiple access points to various networks within the facility. Networks could be Ethernet, Ethernet/IP, Fieldbus, RIO, etc.
20. P&ID: Process and instrumentation diagram.
21. PC: Personal computer.
22. PCIS: Process control and instrumentation system: Includes the entire instrumentation system, the entire control system, and all of the Work specified in the Instrumentation and Control Specifications and depicted on the Instrumentation Drawings. This includes all the PCS and instruments and networking components as well as the various servers, workstations, thin clients, etc.
23. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.
24. PCS: Process control system: A general name for the computerized system that gathers and processes data from equipment and sensors and applies operational controls to the process equipment. It includes the PLCs and/or RIOs, LOIs, HMIs, both LCPs, VCPs, and all data management systems accessible to staff.
25. PJB: Power junction box: An enclosure with terminal blocks that distribute power to multiple instruments.
26. PLC: Programmable logic controller.
27. PS: Power supply.
28. RIO: Remote I/O device for the PLC consisting of remote I/O racks or remote I/O blocks.
29. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
30. SCADA: Supervisory control and data acquisition system: A general name for the computerized system that gathers and processes data from sensors and equipment located outside of the facility, such as wells, lift stations, metering stations, etc.
31. SELV: Safety extra-low voltage.
32. SFP: Small form-factor pluggable.
33. SPDT: Single-pole, double-throw.
34. SPST: Single-pole, single-throw.
35. UPS: Uninterruptible power supply.
36. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, LOI, HMI, etc.
37. WAN: Wide area network: A control or communications network that extends beyond the physical boundaries of the facility.

B. Standards:
   1. American Petroleum Institute (API):
      a. RP 550 - Manual on Installation of Refinery Instruments and Control Systems; Part II-Process Stream Analyzers; Section 5-Oxygen Analyzers.
      b. RP 551 - Process Measurement Instrumentation.
   2. International Organization for Standardization (ISO):
      a. 9001 - Quality Management Systems - Requirements.
   3. International Society of Automation (ISA):
      a. 5.1 - Instrumentation Symbols and Identification.

b. 5.4 - Instrument Loop Diagrams.
c. 20 - Instrument Forms Plus Pro-Combo-Enterprise Version (Microsoft SQL Server Express Database Software based).

4. National Electrical Manufacturers Association (NEMA).
5. National Fire Protection Association (NFPA):
   a. 70 - National Electrical Code (NEC).
6. National Institute of Standards and Technology (NIST).
7. Underwriters Laboratories, Inc. (UL):
   a. 508 - Standard of Safety for Industrial Control Equipment.
   b. 508A - Standard of Safety for Industrial Control Panels.

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. Two-wire transmitter (loop powered): A transmitter that derives its operating power supply from the signal transmission circuit and requires no separate power supply connections. As used in this Section, 2-wire transmitter refers to a transmitter that provides a signal such as 4 to 20 mA 24 VDC regulation of a signal in a series circuit with an external 24 VDC driving potential:
      a. Fieldbus communications signal or both.
   2. Control circuit: Any circuit operating at 120 volts alternating current (VAC) or direct current (VDC) or less, whose principal purpose is the conveyance of information (including performing logic) and not the conveyance of energy for the operation of an electrically powered device.
   3. Digital bus: A communication network, such as PROFIBUS, Foundation Fieldbus, or DeviceNet, allowing instruments and devices to transmit data, control functions, and diagnostic information.
   4. Instrument: A measurement device that includes a sensor for taking the measurement and one or both of the following:
      a. A local display.
      b. A device for communicating the measurement to a remote location such as a PLC or DCS.
   5. Modifications: Changing, extending, interfacing to, removing, or altering an existing circuit.
   6. Panel: An instrument support system that may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems.
   7. Power circuit: Any circuit operating at 90 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.
   8. Powered transmitters: A transmitter that requires a separate power source (120 VAC, 240 VAC, etc.) in order for the transmitter to develop its signal. As used in this Section, the produced signal may be a 4 to 20 mA 24 VDC signal, a digital bus communications signal, or both.
   9. Programmer: Responsible for PLC programming and SCADA/HMI software configuration.

10. RS-485: Also known as TIA-485 or EIA-485. Is a standard defining the electrical characteristics of drivers and receivers for use in serial communications system. Electrical signaling is balanced, and multipoint systems are supported, can be used with data rates up to 10 Mbit/s or at lower speeds distances up to 1,000 meters (4,000 feet).
11. Signal circuit: Any circuit operating at less than 50 VAC or VDC, which conveys analog information or digital communications information.

1.04 DELEGATED DESIGN

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

1.05 SUBMITTALS

A. General:
   1. Adhere to the wiring numbering scheme as specified in Section 16075 - Identification for Electrical Systems throughout the Project:
      a. Uniquely number each wire.
      b. Wire numbers must appear on equipment drawings.
   2. Some items of Work are represented schematically, and are designated for the most part by numbers, as derived from criteria in ISA-5.1:
      a. Employ the nomenclature and numbers specified in this Section and indicated on the Drawings exclusively throughout Shop Drawings, datasheets, and similar Submittals.
      b. Replace any other symbols, designations, and nomenclature unique to a manufacturer's, Supplier's, or Subcontractor's standard methods with those specified in this Section and indicated on the Drawings.

B. Specific Submittal requirements:
   1. Loop drawings:
      a. Submit loop drawings after an accepted Commissioning Test Reports Submittal as specified in Section 17950 - Commissioning for Instrumentation and Controls.
         1) Engineer recommends submitting a sample/template loop drawing for review prior to this Submittal.
      b. General requirements:
         1) Submit loop drawings for every analog, discrete, fieldbus signal, vendor-supplied equipment packages, and control panels.
            a) Includes monitoring, alarming, interlocks, and control devices.
         2) Use equipment and instrument tags as depicted on the P&IDs for all Submittals.
         3) Show and identify each component of each loop or system using requirements and symbols from ISA-5.4.
         4) Provide drawings for every instrumentation loop system:
            a) Furnish a separate drawing sheet for each system or loop diagram.
         5) Nameplates and wire labeling:
            a) As specified in Section 16075 - Identification for Electrical Systems or as indicated on the Drawings.

6) Clearly show modifications to existing circuits:
a) Show existing unmodified wiring to clearly depict the functionality and electrical characteristics of the complete modified circuits.
7) Provide loop drawings in the format indicated in the Contract Drawings.

c. Provide a complete index in the front of each bound volume:
1) Index the loop drawings by systems or process areas.

d. In addition to the ISA-5.4 requirements, show the following details:
1) Functional name of each loop.
2) Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.
3) Show all terminal numbers, regardless of the entity providing the equipment.
4) MCC panel, circuit, and breaker numbers for power feeds to the loops and instrumentation.
5) Terminal assignments associated with every manhole, pull-box, junction box, conduit, and panel through which the loop circuits pass.
6) Show VCP, instrument panel, conduit, junction box, equipment and PCS terminations, termination identification, wire numbers and colors, power circuits, and ground identifications.
7) Cables required for communication requirements.

2. Product data:
a. Provide a technical brochure or bulletin (cutsheet) for each instrument or equipment on the Project, labeled with equipment and instrument tags as depicted on the P&IDs.
1) Submit with the corresponding datasheets.
2) Organization: Index product data in the Submittal by systems or loops.

b. Engineering data:
1) Test data and performance curves, when applicable.

c. Manufacturer's technical reference manuals.

3. Quality Control Submittals:
a. Manufacturer representative qualifications.
b. Manufacturer certificates.
c. Test Plans.
d. Test Reports.

4. Operation and maintenance manuals:
a. Organize the operation and maintenance manuals for each process in the following manner:
1) Section A - Loop Drawings.
2) Section B - Product Data.
3) Section C - Test Results.
4) Section D - Operational Manual.
5) Section E - Spare Parts List.

1.06 QUALITY ASSURANCE

A. Manufacture instruments at facilities certified to the quality standards of ISO 9001.

B. Provide equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

B. Area classifications:
   1. Furnish enclosures that match the area classifications as specified in Section 16050 - Common Work Results for Electrical.

1.09 ADMINISTRATIVE REQUIREMENTS (NOT USED)

PART 2 PRODUCTS

2.01 GENERAL

A. Furnish meters, instruments, and other components that are the most recent field proven models marketed by their manufacturers at the time of Submittal of the Shop Drawings unless otherwise specified to match existing equipment.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Non-conditioned spaces:
   1. Provide additional temperature conditioning equipment to maintain equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer’s guidelines.

B. Outdoor installations:
   1. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.
   2. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in the Sections for the equipment.

C. This facility includes classified areas:
   1. As specified in Section 16050 - Common Work Results for Electrical.
   2. Provide enclosures suitable for the area classification.
   3. Where suitable enclosures are not available, utilize other methods such as intrinsic safety barriers.

D. Unless otherwise specified, furnish individual instruments that have a minimum accuracy of within 0.5 percent of full scale and a minimum repeatability of within 0.25 percent of full scale.

E. Discrete circuit configuration:
   1. Configure discrete control circuits to fail safe, on loss of continuity, or loss of power.
   2. Alarm contacts: Fail to the alarm condition.

F. Grounding:
   1. Analog signal cables shields shall only be grounded at a single point in the loop. Unless otherwise noted, ground signal cable shields at control panel.
   2. For communication and data line signal cable shields and drain wires should be grounded at both ends of the cable.
   3. Insulate the shielding and exposed drain wire for each signal cable with heat-shrink tubing.
   4. Terminate the signal cable shield on a dedicated grounding terminal block.
   5. Provide isolating amplifiers within control panels for field equipment possessing a grounded input or output, except when the panel circuit is galvanically isolated.

G. Terminal blocks:
   1. Schematics do not reflect the actual conductor routing. Add intermediate terminal in enclosures and equipment as needed based on the actual conductor routing.

H. Signal transmission:
   1. Analog signals:
      a. Furnish analog measurements and control signals that vary in direct linear proportion to the measured variable, unless otherwise indicated.
      b. Furnish electrical analog signals outside control panels that are 4 to 20 mA 24 VDC, except as indicated.
      c. Electrically or optically isolate analog signals from other signals.
      d. Furnish regulated analog signals that are not affected by changes in supply voltage or load resistance within the unit's rating.
      e. Maintain the total 4 to 20 mA loop impedance to 10 percent below the published value at the loop operating voltage.
      f. Where necessary, reduce loop impedance by providing current-to-current (I/I) isolation amplifiers for signal re-transmission.
   2. Pneumatic signals: 3 to 15 pounds per square inch gauge.
   3. Discrete input signals: As indicated in the controller hardware specification.
   4. Discrete output signals:
      a. Dry contacts or TRIAC outputs (with express written approval by the Engineer) as needed to coordinate with the field device.
      b. Provide external terminal block mounted fuse with blown fuse indication for discrete outputs.
      c. Provide interposing relays for discrete outputs for voltage and/or current compatibilities.
      d. Provide interposing relays as required for functionality of the control circuit.
   5. Signal performance and design criteria:
      a. Stability:
         1) After controls have taken corrective action, oscillation of the final control element shall not exceed 2 cycles per minute or a magnitude of motion of 0.5 percent of full travel.

b. Response:
    1) Any change in setpoint or controlled variable shall produce a corrective change in position of the final control element and stabilized within 30 seconds.
c. Agreement:
    1) Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.
d. Repeatability:
    1) For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position the final element.
e. Sensitivity:
    1) Controls shall respond to a setpoint deviations and measured variable deviations within 1.0 percent of full scale.
f. Performance:
    1) Instruments and control devices shall perform in accordance with the manufacturers' specifications.

2.03 ACCESSORIES

A. Provide flow conditioning devices or other required accessories as needed to meet the accuracy requirements in the Contract Documents.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Cable and conductor termination:
    1. Terminate cables and conductors on terminal blocks.
    2. Terminal block enclosures:
        a. Suitable for the area classification as specified in Section 16050 - Common Work Results for Electrical.

B. Surge protection:
    1. Provide outdoor field instrument loops with voltage surge protection units installed on the instruments and the panel.
    2. Individually fuse each 4 to 20 mA DC loop with a 1/2-amp fuse between power supplies and receiver surge protectors.
    3. Provide voltage surge protection for 4-wire transmitters and analyzers:
        a. Protect both power source and signal loop.

3.04 RE-INSTALLATION (NOT USED)

3.05 COMMISSIONING (NOT USED)

3.06 FIELD QUALITY CONTROL

A. Functional Testing:
   1. As specified in Section 17950 - Commissioning for Instrumentation and Controls.
   2. Assist with troubleshooting and correcting instrumentation and control issues.

3.07 ADJUSTING (NOT USED)

3.08 CLEANING

A. Vacuum clean control panels and enclosures before process start-up and again after final completion of the Project.

B. Clean panel surfaces.

C. Return to new condition any scratches and/or defects.

D. Wipe instrument faces and enclosures clean.

E. Leave wiring in panels, manholes, boxes, and other locations in a neat, clean, and organized manner:
   1. Neatly coil and label spare wiring lengths.
   2. Shorten, re-terminate, and re-label excessive spare wire and cable lengths, as determined by the Engineer.

END OF SECTION

SECTION 17733

CONTROL SYSTEMS: NETWORK MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Materials and equipment used in process control and LAN networks, including:
      a. Patch panels and other data network hardware.
      b. Related accessories.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Standards:
   1. Electronic Industries Alliance (EIA):
      a. 310-E - Cabinets, Racks, Panels, and Associated Equipment.
   2. Institute of Electrical and Electronics Engineers (IEEE):
      a. 802.1X - Standard for Local and Metropolitan Area Networks—Port-Based Network Access Control.
      b. 802.3 - Standard for Ethernet.
      c. 802.11b - Standard for Information Technology - Telecommunications and information exchange between systems - Local and Metropolitan networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Higher Speed Physical Layer (PHY) Extension in the 2.4 GHz band.
   3. National Electrical Manufacturers Association (NEMA):
      a. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).
   4. National Fire Protection Association (NFPA):
      a. 70 - National Electrical Code (NEC).
   5. Telecommunications Industry Association (TIA):
      a. 569 - Telecommunications Pathways and Spaces.
      b. 607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
   6. Underwriters Laboratories, Inc. (UL).

1.03 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures.

B. Anchoring and bracing.

1.04 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Include information on all network equipment.
   2. Manufacturer's operation and installation instructions.

C. Shop Drawings:
   1. Complete set of drawings, including, but not limited to:
      a. System block diagram showing relationship and connections between devices provided under this Contract, including connections to any existing equipment.
      b. Include manufacturer and model information, and address settings.
      c. Network riser diagram.
      d. Network port diagram, which physically locates all ports within the facility, and identifies their patch panel and switch port.
      e. Construction drawings for equipment cabinets, including dimensions, identification of components, preparation and finish data, and nameplates.
      f. Electrical connection diagrams.
      g. Complete grounding requirements.
   2. Furnish data sheets for each component together with a technical product brochure or bulletin:
      a. Manufacturer's model number.
      b. Project equipment tag.
   3. Complete and detailed bills of materials broken up by each cabinet. Each bill of material item will include the following:
      a. Quantity.
      b. Description.
      c. Manufacturer.
      d. Part numbers.

D. Calculations:
   1. Cooling calculations, including, but not limited to:
      a. Highest expected ambient temperature for the enclosure's location.
      b. Internal heat load.
      c. Exposure to direct sunlight.
      d. Dimensions of the enclosure in inches.
      e. Maximum allowable temperature inside the enclosure, based on the lowest operating temperature limit of the installed components.

E. Test reports:
   1. As specified in Section 16125 - Fiber Optic Cable and Appurtenances and Section 17950 - Commissioning for Instrumentation and Controls.
   2. Signed test results as described in this Section.
   3. Test results shall include:
      a. Narrative describing the test procedures followed.
      b. Block diagram of test set up.
      c. Manufacturer's information on test equipment used.
      d. Detailed test results.
      e. A narrative summarizing the results of the testing and identifying any further action required.

F. Operating manuals:
   1. Complete installation, operation, calibration, and testing manuals

G. Record drawings:
   1. As specified in Section 17950 - Commissioning for Instrumentation and Controls.
   2. Electrical connection diagrams shall be revised to reflect any changes made in the field and submitted as record drawings.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.06 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.07 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.08 WARRANTY (NOT USED)

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Vendor shall manufacture using low VOC-based materials to provide superior indoor air quality demonstrated by Greenguard certification.

2.03 MANUFACTURERS

A. As listed below in the individual component paragraphs.

2.04 MANUFACTURED UNITS

A. Patch panels:
   1. Fiber optic patch panels:
      a. General:
         1) Optical fiber cables shall be provided with strain relief and terminated at a fiber patch panel. Final connections between the patch panel and the fiber optic network equipment shall be made via factory tested fiber optic patch cords.
         2) Fiber cable strands shall be terminated at the patch panels; no loose fiber strands are allowed.
         3) Provide space for excess fiber and provide strain relief for the fiber cable.
         4) Fiber cables shall be installed such that the outer sheath of the cable is carried into the interconnect enclosure or patch panels before breaking out buffer tubes.
         5) Fiber connectors: LC.

b. 19-inch rack mounted:
    1) Manufacturers: The following, no equal:
        a) Corning CCH Series.
    2) Properties:
        a) Housing:
            (1) Use for combination of splicing and termination of fiber-optic building cable or outside plant cables.
            (2) Up to 4U rack units in height.
            (3) Fully enclosed.
            (4) Interconnect and cross-connect capability.
            (5) Modules shall be interchangeable.
            (6) Compatible with connector panels, modules, and cassettes.
    3) Accessories:
        a) Hinged front doors.
        b) Front cable management trough.
        c) Top cover panel.
        d) Configurable internal strain relief.
        e) Blanks for unused connector panels.
        f) Splice tray.
c. Wall mounted:
    1) Manufacturers: The following, no equal:
        a) Corning WCH Series.
    2) Properties:
        a) Use for the termination of a single cable outside of cabinets, in small enclosures or as indicated on the plans.
        b) Wall-mounted fiber patch panels shall be provided as a complete unit, including the housing, connector panels, splice trays, and the fiber connectors.
        c) Physical protection for incoming and outgoing cables and patch cords.
    3) Accessories:
        a) Door lock.
        b) Blanks for unused connector panels.
        c) Cassette

2.05 ACCESSORIES

A. Provide duplex patch cords to connect the interface cards provided with the associated patch panels.

B. Provide dust covers or plugs for unused ports.

PART 3 EXECUTION

3.01 PREPARATION (NOT USED)

3.02 INSTALLATION

A. Provide installation and configuration for the new and existing managed Ethernet switches. Provide configuration of the Ethernet switch network for a complete,

functioning plant control system as indicated on the Drawings and as specified in this Section.

1. Refer to SCADA block diagrams for new network connections.

B. Cable management:
   1. Cables and equipment shall be installed in strict conformance with the manufacturer's recommendations.
   2. Install cable using lubricant designed for cable pulling.
   3. Install hook-and-loop wrap on all cable bundles within the network rack/enclosure. Plastic tie-wraps are not acceptable.
   4. Install network cables without splices.
   5. Installed bend radius shall be a minimum of 10 times the cable diameter.
   6. Terminate pairs at the jack and patch panel.
   7. Route cables through cable management or other form of containment. No loose, unsupported cables are permitted to span across network equipment.
   8. Use corner strips to protect cables from edges inside ducts and to maintain bend radius requirements.

C. Internal rack wiring:
   1. Cables shall be installed avoiding sharp bends.
   2. Provide enough working space inside rack or cabinets such that closing enclosure doors does not crush or compress cabling.
   3. Bundle cables together in groups of no more than 12.
   4. Route cables from both sides of the rack to patch panels. Do not bring all bundles from a single side.
   5. No cabling shall obstruct equipment ventilation.
   6. Individual pairs will be untwisted less than 1/2-inch at termination points.
   7. Ground enclosure and equipment in accordance with TIA-607.
      a. Individually bond network equipment chassis to the rack's grounding busbar. Do not daisy-chain bonding conductors.
      b. Size the bonding conductor in accordance with the network equipment manufacturer's recommendation or #10 AWG, whichever is larger.

D. External rack wiring:
   1. Do not install fiber cables in non-continuous cable supports such as cable ladders or wire baskets without radius cable supports or solid bottoms.
   2. Maintain cable separation in accordance with TIA-569.
      a. Install cables a minimum of 40 inches away from electrical motors and transformers.
      b. Install cables a minimum of 12 inches away from fluorescent lighting.

E. Cables and terminations shall be labeled with cable designations as specified in Section 16075 - Identification for Electrical Systems.

F. Each data port shall be individually labeled with its patch panel/switch port ID:
   1. Labeling must be printed. No handwritten labels will be allowed.

G. At the completion of the wiring installation, provide the following documentation:
   1. A plan-view of the premise(s) showing the jack numbering scheme.
   2. A printed certification report for the entire wiring installation showing compliance with TIA specifications for data cable.

3. Reports such as those generated by Fluke DSP cable certification equipment meet this requirement.

3.03 DEMONSTRATION AND TRAINING

A. After completion of the cable system tests and before placing the system in operation, power up all devices installed on the LAN and verify communication between the devices.

B. Verify that all equipment is operable on the network simultaneously. Confirm that all network device communications settings are properly configured.

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 ADJUSTING

A. Perform firmware installations, configuration, and other set-up, as required, to place the network into proper operation.

END OF SECTION

SECTION 17950

COMMISSIONING FOR INSTRUMENTATION AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Testing requirements that apply to process control and instrumentation systems for the entire Project.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Abbreviations:
   1. PTO: Profibus Trade Organization.

C. Standards:
   1. Telecommunications Industry Association (TIA).

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. 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.
   2. Loop validation tests - Signals are tested from the field device to the PLC.
   3. Permanent link: Fixed portion of cabling installed between an equipment outlet and its immediate distributor or between 2 distributors.

1.04 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures.

B. General:
   1. Reference additional detailed test Submittal scheduling and prerequisite requirements as specified in the sequencing article of Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Overall test plan:
   1. Develop the PCIS system test Submittals in consultation and cooperation with applicable Subcontractors.
   2. Develop and submit an overall testing plan for the PCIS. Overall test plan to be reviewed and approved by the Engineer before detailed test plans, procedures, and forms will be reviewed.

3. Describe the test phases as they apply specifically to this Project and each process system.
4. Provide a preliminary testing schedule to show the sequence of tests and commissioning as they apply to each process system and each PLC.
5. Provide a description of factory tests. Describe what equipment will be included, what testing equipment will be used, and the simulator that will be used.
6. Provide examples of proposed forms and checklists.

D. Test procedures:
1. Develop and submit detailed test procedures to show that the integrated SCADA system hardware and software is fully operational and in compliance with the requirements specified in the Contract Documents.
2. Provide a statement of test objectives for each test.
3. Prepare specific procedures for each process system.
4. Describe sequentially the steps to be followed in verifying the correct operation of each process system, including features described in the loop descriptions, control strategies, and shown in the P&IDs. Implied or generic test procedures are not acceptable.
5. Specify who will perform the tests, specifically what testing equipment will be used (including serial numbers and NIST-traceable calibration), and how the testing equipment will be used.
6. Describe the expected role of the Engineer, as well as any requirements for assistance from the Owner's staff.
7. Provide the forms and checklists to be used.

E. Test forms:
1. Submit completed calibration forms, test forms, and checklists.
    a. Test forms shall include the detailed test procedures or shall include clear references to separate pages containing the complete test procedure applicable to each form. If references to procedures are used, the complete procedure shall be included with each test binder.
    b. Every page of each test form shall include Project name, date, time, name of person conducting the test, signature of person conducting the test, and for witnessed tests, place for signature of person (Engineer and Owner) witnessing the test.
    c. Sample test forms at the end of this Section show the minimum required content:
        1) Sample test forms have not been customized for this Project.
        2) Develop and submit test forms customized for the Project and meeting the specified test and Submittal requirements.

F. Testing binders:
1. Sub-system to be tested: Provide and submit a test binder containing test procedures and individual forms for the test. References to other documents for test procedures and requirements are not acceptable.
2. Fill out in advance, headings and all other information known before the test.
3. Include applicable test plan information, as well as a list of test prerequisites, test personnel, and equipment.
4. Include or list reference material and provide separately at the time of the test.
5. Record test results and verify that all test requirements and conditions have been met.

G. Furnish Commissioning Submittals listed below, as specified in this Section, and Section 01770 - Closeout Procedures:
   1. Manufacturer's representative qualifications.
   2. Owner Training.

H. Test reports:
   1. At the conclusion of each test, submit a complete test report, including test results and certifications.
   2. Include completed test binders, forms, and checklists.
   3. Submission, review, and acceptance of each test report is required before the start of the sub-system.

1.05 QUALITY ASSURANCE

A. Test personnel:
   1. Furnish qualified technical personnel to perform calibration, testing, and verification. Test personnel are required to be familiar with this Project and the equipment, software, and systems before being assigned to the test program.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 INSTALLATION

A. Installation supervision:
   1. Provide as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.03 COMMISSIONING

A. Testing and training phase:
   1. Installation testing:
      a. Loop check:
         1) Performed by the Contractor.
         2) Cabling installed, terminated, and labeled.
         3) Perform continuity check of wiring to each field device through intermediate devices to field terminals in the cabinet.
         4) Complete loop check form for each device.
         5) Submit loop check test results before proceeding to the next step.
      b. Loop validation tests:
         1) Performed by the Contractor, ICSC, and the manufacturer's representative, working together, and witnessed by the Owner or Owner's representative.
         2) Perform tests on the signal from each field device through intermediate devices to the I/O module on the PLC.
            a) PLC may or may not be connected to the network.

3) Engineer approval of the loop validation test Submittal is required before proceeding to CEET.

c. Copper Ethernet cable acceptance testing:
   1) Testing procedures and field-test instruments shall be in accordance with applicable requirements of:
      a) TIA-1152 - Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling.
      b) TIA-568.0-E - Generic Telecommunications Cabling for Customer Premises.
      c) TIA-568.1-E - Commercial Building Telecommunications Infrastructure Standard.
      d) TIA-568.2-D - Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
      e) Copper Ethernet cable installation testing as specified in Section 16950 - Field Electrical Acceptance Tests.
   2) Testing shall be performed by trained technicians who have successfully completed an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
      a) Manufacturer of the connectors or cable.
      b) Manufacturer of the test equipment used for the field certification.
      c) Training organizations (e.g., BICSI).
   3) Submit the following information before testing begins:
      a) Manufacturer's catalog sheets, specifications, and the most recent calibration report for the test equipment.
      b) Certificate of testing technician's training.
      c) A schedule of balanced twisted-pair copper links to be tested, including:
         (1) Cable identification as it appears on the cable records.
         (2) Cable identification as it appears on the individual test reports.
         (3) Cable identification as specified in Section 16075 - Identification for Electrical Systems.
      d) Sample test reports.
      e) Installed cabling Permanent Links shall be field-tested and pass the test requirements and analysis as described below:
         (1) Any Permanent Link that fails these requirements shall be diagnosed and corrected.
         (2) Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected Permanent Link meets performance requirements.
         (3) Final and passing result of the tests for Permanent Links shall be provided in the test results documentation in accordance with the testing requirements.
      f) Acceptance of the test results shall be given in writing after the Project is fully completed and tested in accordance with the Contract Documents and to the satisfaction of the Engineer.
   4) Cable field-test instruments:
      a) Field-test instrument shall be within the calibration period recommended by the manufacturer, typically 12 months.

b) Certification tester requirements:
   (1) Level III in accordance with TIA-1152.
   (2) Independent verification of accuracy.
   (3) Must be capable of storing more than 10,000 results for all required measurements.
   (4) Manufacturers: The following or equal:
      (a) Fluke CableAnalyzer Industrial Ethernet Kit, DSX2-5-IE-K1.
c) Permanent Link adapters:
   (1) Use the manufacturer's adapter for connecting to tested equipment.
      (a) Patch cables shall not be used for testing.
   (2) RJ45 plug must meet the requirements for NEXT, FEXT, and return loss in accordance with TIA-568.2-D Annex C.
d) Measurement capabilities:
   (1) Wire map.
   (2) Length.
   (3) Propagation delay.
   (4) Delay skew.
   (5) DC loop resistance.
   (6) DC resistance unbalance.
   (7) Insertion loss.
   (8) NEXT (near-end crosstalk).
   (9) PS NEXT (power sum near-end crosstalk).
   (10) ACR-N (attenuation to crosstalk ratio near-end).
   (11) PS ACR-N (power sum attenuation to crosstalk ratio near-end).
   (12) ACR-F (attenuation to crosstalk ratio far-end).
   (13) PS ACR-F (power sum attenuation to crosstalk ratio far-end).
   (14) Return loss.
   (15) TCL (transverse conversion loss).
   (16) ELTCTL (equal level transverse conversion transfer loss).
   (17) Time domain reflectometer.
   (18) Time domain crosstalk analyzer.

5) Testing requirements:
   a) Field-test instruments shall have the latest software and firmware installed.
   b) Permanent Link test results, including the individual frequency measurements from the tester shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.
   c) Testing shall be performed on each cabling segment from connector to connector:
      (1) Sampling is not acceptable.
   d) Installer shall build a reference link:
      (1) Components shall be anchored so it is not possible to disturb them.

(2) Technician is to conduct a Permanent Link test each day, for each type of category cable used, to ensure no degradation of the tester or its Permanent Link adapters.

e) Unless noted otherwise tests shall use the following frequency resolution:
   (1) 1 to 31.25 MHz: 150 kHz.
   (2) 31.25 to 100 MHz: 250 kHz.
   (3) 100 to 250 MHz: 500 kHz.

f) Wire map measurement:
   (1) Wire map test is intended to verify pin-to-pin termination at each end and check for installation connectivity errors. For each of the 8 conductors in the cabling, the wire map indicates:
      (a) Continuity to the remote end.
      (b) Shorts between any 2 or more conductors.
      (c) Reversed pairs.
      (d) Split pairs.
      (e) Transposed pairs.
      (f) Distance to open on shield.
      (g) Any other miss-wiring.
      (h) Correct connectivity of telecommunications outlets/connectors is defined in TIA-568.2-D:
         - 2 color schemes are permitted.
         - User shall define which scheme is to be used.
         - Field tester shall document which color scheme was used.

g) Length measurement:
   (1) Record the length of each cable. Use the physical length of the link calculated using the pair with the shortest electrical delay for reporting and to determine pass/fail.
   (2) Pass or fail criteria is based on the maximum length allowed for the Permanent Link as specified in TIA-568.2-D plus the nominal velocity of propagation (NVP) uncertainty of 10 percent. For a Permanent Link, the length measurement can be 325 feet before a fail is reported.

h) Propagation delay measurement:
   (1) Is the time it takes for a signal to reach the end of the link.
   (2) Measurement shall be made at 10 MHz in accordance with TIA-1152.
   (3) Propagation delay of each balanced twisted pair shall be recorded.
   (4) Is not to exceed 498 ns in accordance with TIA-568.2-D Section 6.4.21.

i) Delay skew measurement:
   (1) Is the difference in propagation delay at 10 MHz between the shortest delay and the delays of the other wire pairs.
   (2) Delay skew of each balanced twisted pair shall be recorded.
   (3) Is not to exceed 44 ns in accordance with TIA-568.2-D Section 6.4.22.

j) DC resistance:
   (1) Often reported as resistance, is the loop resistance of both conductors in the pair.
   (2) Is not specified in TIA-1152 but shall be recorded for all 4 pairs.

k) DC resistance unbalance:
   (1) Often reported as resistance unbalance, is the difference in resistance of the 2 wires within the pair.
   (2) Is not specified in TIA-1152 for a Permanent Link but shall be recorded for all 4 pairs.

l) Insertion loss:
   (1) Is the loss of signal strength over the cabling (in dB).
   (2) Worst case shall be reported for all 4 pairs in one direction only.
   (3) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.10.

m) NEXT (near-end crosstalk):
   (1) Is the difference in amplitude (in dB) between a transmitted signal and the crosstalk received on other wire pairs at the same end of the cabling.
   (2) Shall be measured in both directions (12 pair to pair possible combinations).
   (3) Both worst case and worst margins shall be reported.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.11.
   (5) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
   (6) Time domain crosstalk data shall be stored for any marginal or failing NEXT results.

n) PS NEXT (power sum near-end crosstalk):
   (1) Is the difference (in dB) between the test signal and the crosstalk from the other pairs received at the same end of the cabling.
   (2) Shall be measured in both directions (8 pair possible combinations).
   (3) Both worst case and worst margins shall be reported.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.12.
   (5) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
   (6) Time domain crosstalk data shall be stored for any marginal or failing PS NEXT results.

o) ACR-N (attenuation crosstalk ratio near-end):
   (1) Is a calculation of NEXT minus insertion loss of the disturbed pair in dB.
   (2) Shall be calculated in both directions.
   (3) Is not specified in TIA-1152 but shall be recorded for all 12 possible combinations.

p) PS ACR-N (power sum attenuation crosstalk ratio near-end):
   (1) Is a calculation of PS NEXT minus insertion loss of the disturbed pair in dB.
   (2) Shall be calculated in both directions.
   (3) Is not specified in TIA-1152 but shall be recorded for all 8 possible combinations.
q) ACR-F (attenuation crosstalk ratio far-end):
   (1) Is a calculation of FEXT minus insertion loss of the disturbed pair in dB.
   (2) Shall be measured in both directions (24 pair to pair possible combinations).
   (3) Both worst case and worst margins shall be reported.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.14.
   (5) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
r) PS ACR-F (power sum attenuation crosstalk ratio far-end):
   (1) Is a calculation of PS FEXT minus insertion loss of the disturbed pair in dB.
   (2) Shall be measured in both directions (8 pair possible combinations).
   (3) Both worst case and worst margins shall be reported.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.16.
   (5) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
s) Return loss:
   (1) Is the difference (in dB) between the power of a transmitted signal and the power of the signals reflected back.
   (2) Shall be measured in both directions (8 pair possible combinations).
   (3) Both worst case and worst margins shall be reported.
   (4) Shall be ignored at all frequencies where the insertion loss is less than 3 dB for that pair.
   (5) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.9.
   (6) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
   (7) Time domain reflectometer data shall be stored for any marginal or failing return loss results.
t) TCL (transverse conversion loss):
   (1) Is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at the near-end on the same wire pair.
   (2) Shall be measured in both directions.
   (3) Is not specified in TIA-1152 for a Permanent Link but shall be recorded for all 8 possible combinations.
u) ELTCTL (equal level transverse conversion transfer loss):
   (1) Is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at

the far end on the same wire pair minus the insertion loss of that pair.
(2) Shall be measured in both directions.
(3) Is not specified in TIA-1152 for a Permanent Link but shall be recorded for all 8 possible combinations.

6) Test results documentation:
a) Detailed test results documentation data is to be provided in an electronic database for each tested balance twisted pair and shall contain the following information:
(1) Overall pass/fail evaluation of the link-under-test.
(2) Date and time the test results were saved in the memory of the tester.
(3) Identification of the customer site as specified by the end user.
(4) Name of the test limit selected to execute the stored test results.
(5) Name of the personnel performing the test.
(6) Version of the test software and the version of the test limit database held within the test instrument.
(7) Manufacturer, model, and serial number of the field-test instrument.
(8) Adapters used.
(9) Factory calibration date.
(10) Wire map.
(11) Propagation delay values, for all 4 pairs.
(12) Delay skew values, for all 4 pairs.
(13) DC resistance values, for all 4 pairs.
(14) DC resistance unbalance, values for all 4 pairs.
(15) Insertion loss, worst case values for all 4 pairs.
(16) NEXT, worst case margin and worst case values, both directions.
(17) PS NEXT, worst case margin and worst case values, both directions.
(18) ACR-F, worst case margin and worst case values, both directions.
(19) PS ACR-F, worst case margin and worst case values, both directions.
(20) Return loss, worst case margin and worst case values, both directions.
(21) TCL, worst case values both directions.
(22) ELTCTL, worst case values, both directions.
(23) Time domain crosstalk data if the link is marginal or fails.
(24) Time domain reflectometer data if the link is marginal or fails.
b) Maintain a set of “red-line” throughout during construction:
(1) Drawings shall be available for review at any time as requested by the Owner or Engineer.
(2) Provide record copy drawings at the end of the Project.
(a) Shall be in CAD format and include notations reflecting the as-built conditions of any additions to or variation from the drawings provided, such as, but not limited to, cable paths and termination point.

(3) As-built drawings shall include, but are not limited to, block diagrams, frame and cable labeling, cable termination points, equipment room layouts and frame installation details.
(4) As-builts shall include field changes made up to construction completion:
(a) Field directed changes to pull schedule.
(b) Horizontal cable routing changes.

7) Associated detail drawings. Engineer approval of the copper Ethernet cable acceptance-testing Submittal is required before proceeding to CEET.

2. Functional Testing:
a. General:
1) Testing to demonstrate proper operation of systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.
2) Performed by the Contractor, ICSC, and the manufacturer's representative, and programmer working together, with assistance from the Owner or the inspection staff, as needed.
3) Additional tests are specified in other instrumentation and control Sections.
4) Follow approved detailed test procedures and check lists for Functional test activities.
b. Control logic operational validation:
1) The purpose of control logic validation is to field test the operation of the complete control system, including all parts of the HMI/SCADA system, control panels (including vendor control panels), control circuits, control stations, monitored/controlled equipment, and final control elements.
2) Demonstrate control functionality shown on the P&IDs, control schematics, and other drawings, and specified in the loop descriptions, control strategies, electrical Specifications, and mechanical equipment Specifications.
3) Test in detail on a function-by-function and sentence-by-sentence basis.
4) Thoroughly test hardware and software functions, including hardwired and software control circuit interlocks and alarms.
5) Test final control elements, controlled equipment, control panels, and ancillary equipment under startup, shut down, and steady-state operating conditions to verify logic and control is achieved.
6) Control logic validation tests to include, but not be limited to, a repeat of control logic tests from the FAT, modified and expanded to include field instruments, control panels, circuits, and equipment.
7) Functional certification:
a) Including test forms with test data entered, submitted to the Engineer with a clear and unequivocal statement that Functional test requirements have been satisfied.

3.04 SCHEDULES (NOT USED)

END OF SECTION