



JORDAN VALLEY WATER CONSERVANCY DISTRICT

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
Project Manager: Kevin Rubow, P.E. (801) 565-4300

BIDDING REQUIREMENTS AND CONTRACT DOCUMENTS VOLUME 1 OF 2 APRIL 2026

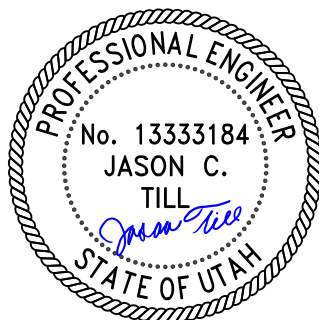
for the construction of the
**3145 WEST 11400 SOUTH
PUMP STATION IMPROVEMENTS**
JVWCD Project No. 4373



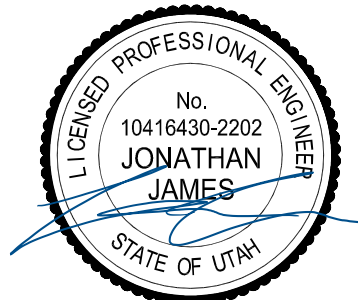
Jacobs Engineering
6440 South Millrock Drive, Suite 300
Holladay, UT 84121
Project Manager: Ryan Willeitner, P.E. (385) 474-8564



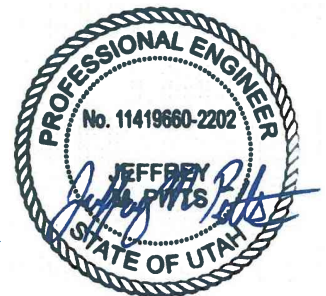
DIGITALLY SIGNED:
4/28/2026
Ryan Willeitner, P.E.
General



DIGITALLY SIGNED:
04/28/2026
Jason Till, P.E.
Structural



DIGITALLY SIGNED: 4/28/2026
Jonathan James, P.E.
Electrical



DIGITALLY SIGNED:
04/28/2026
Jeff Pitts, P.E.
Mechanical

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BIDDING REQUIREMENTS

NOTICE INVITING BIDS

PROJECT NAME: 3145 West 11400 South Pump Station Improvements

DESCRIPTION OF WORK: The Work of this Contract comprises Installation of two 200 horsepower (HP) pumps and adjustable frequency drives (AFDs) at an existing pump station facility. The work also includes the installation of a 30-inch butterfly valve within an existing vault and minor piping improvements at the pump station.

DISTRICT WEB SITE AND PLANHOLDERS LIST

Prospective bidders must register at the District's web site (www.jvwcd.gov) under "Engineering Projects". Prospective bidders are required to check the District's web site for any addenda prior to submitting a responsive bid. The District's web site will be used to publish updated information relative to the project, including a planholders list.

RECEIPT OF BIDS: Sealed bids will be received at the administration office of the Jordan Valley Water Conservancy District, Owner of the Work, located at 8215 South 1300 West, West Jordan, Utah 84088, until **3:00 PM on Thursday, May 21, 2026**, for construction of the "3145 West 11400 South Pump Station Improvements". Electronic bids may also be submitted in adobe .pdf format to ellisad@jvwcd.gov. JWCD requests that electronic bids be submitted 15 minutes prior to the bid opening deadline. A public bid opening will be held at the bid due time. Attendance is not required. Bid results will be posted to the District's website within 24 hours of the bid opening.

OBTAINING CONTRACT DOCUMENTS: The Contract Documents are entitled, "3145 West 11400 South Pump Station Improvements". All Contract Documents may be obtained, online at www.jvwcd.gov under "Engineering Projects".

OPENING OF BIDS: The bids will be publicly opened and read at the time and location identified above.

SITE OF WORK: The work is located at 3145 West 11400 South, South Jordan, Utah.

PRE-BID SITE VISIT: A non-mandatory pre-bid visit will be held at **1:00 PM on Wednesday, May 13, 2026**, at the site of work, 3145 West 11400 South. It is recommended that Bidders attend to see the existing pump station and ask questions regarding the project.

COMPLETION OF WORK: All work shall be Substantially Complete by **May 1, 2027**.

AWARD OF CONTRACT: An Award of Contract, if it were awarded, will be made within 60 calendar days of the opening of bids.

NOTICE TO PROCEED: A Notice to Proceed, if it were issued, will be made within 60 calendar days of the Notice of Award.

BID SECURITY: Each bid shall be accompanied by a certified or cashier's check, money order or bid bond in the amount of five percent of the total bid price payable to the Jordan Valley Water Conservancy District as a guarantee that the bidder, if its bid is accepted,

NOTICE INVITING BIDS

will promptly execute the contract, provide evidence of worker's compensation insurance, and furnish a satisfactory faithful performance bond in the amount of 100 percent of the total bid price and a payment bond in the amount of 100 percent of the total bid price.

ADDRESS AND MARKING OF BID: The envelope enclosing the bid shall be sealed and addressed to the Jordan Valley Water Conservancy District and delivered or mailed to 8215 South 1300 West, West Jordan, Utah 84088. The envelope shall be plainly marked in the upper left-hand corner with the name and address of the bidder and shall bear the words "Bid for," followed by the title of the Contract Documents for the work and the date and hour of opening of bids. The certified or cashier's check, money order, or bidder's bond shall be enclosed in the same envelope with the bid. Electronic bids shall be submitted to the engineering administrative assistant, ellisad@jvwcd.gov as an email attachment with the words "Bid for," followed by the title of the Contract Documents for the work and the date and hour of opening of bids in the subject line of the email.

PROJECT ADMINISTRATION: All questions relative to this project prior to the opening of bids shall be directed to the Engineer for the project. It shall be understood, however, that no interpretations of the specifications will be made by telephone, nor will any "or equal" products be considered for approval prior to award of contract.

ENGINEER

Jacobs Engineering
6440 South Millrock Drive, Suite 300
Holladay, Utah 84121
Telephone: (385) 474-8564
Project Engineer: Ryan Willeitner, P.E.
Email: ryan.willeitner@jacobs.com

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 in the interest of the Owner.

OWNER

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088
(801) 565-4300
Project Manager: Kevin Rubow, P.E.
Email: KevinR@jvwcd.gov

JORDAN VALLEY WATER CONSERVANCY DISTRICT

INSTRUCTIONS TO BIDDERS

FORM OF BID: The bid shall be made on the bidding schedule(s) bound herein. The bid shall be enclosed in a sealed envelope bearing the name of the bidder and name of the project. In the event there is more than one bidding schedule, the bidder may bid on any individual schedule or on any combination of schedules.

DELIVERY OF BID: 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 his bid is received in proper time.

WITHDRAWAL OF BIDS: Bids shall be unconditionally accepted without alteration or correction, excepting that bidder may by means of written request, signed by the bidder or his properly authorized representative withdraw his bid. 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.

OPENING OF BIDS: The bids will be publicly opened and read at the time and place stipulated in the Notice Inviting Bids.

MODIFICATIONS AND ALTERNATIVE BIDS: Unauthorized conditions, limitations, or provisions attached to a bid may render it non-responsive and may cause its rejection. The completed bid forms shall be without interlineations, alterations, or erasures. Alternative bids will not be considered unless called for. Oral, telegraphic, or telephonic bids or modifications will not be considered.

DISCREPANCIES IN BIDS: In the event there is more than one bid item in a bidding schedule, the bidder shall furnish a price for all bid items in the schedule; failure to do so may render the bid non-responsive and subject to 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 Contractor shall be bound by said Correction. In the event there is more than one bid item in a bidding 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 Contractor shall be bound by said correction.

BID SECURITY: 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 a contract within 10 calendar days after receipt of the contract from 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 Notice Inviting Bids. In case the apparent low bidder refuses or fails to enter into such contract or fails to provide the required insurance and insurance certificates, 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 his bid guarantee, he shall use the bid bond bound herein, or one conforming substantially to it in form.

INSTRUCTIONS TO BIDDERS

BIDDER'S EXAMINATION OF CONTRACT DOCUMENTS AND SITE

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

1. Examine Contract Documents thoroughly.
2. Visit the site to become familiar with local conditions that may affect cost, progress, performance, or furnishing of the work.
3. Consider federal, state and local laws and regulations that may affect cost, progress, and performance of furnishing of the work.
4. Study and carefully correlate the Bidder's observations with the Contract Documents.
5. Notify the Engineer of all conflicts, errors, or discrepancies in the Contract Documents.

Reference is made to the Supplemental General Conditions for identification of:

1. Those reports of exploration and tests of subsurface conditions at the site, which have been utilized by the Engineer in the preparation of the Contract Documents.
2. Those drawings 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 contiguous to the site and which were utilized by the Engineer in the preparation of the Contract Documents. Copies of such reports and drawings are available for inspection at the office of the Owner.

Information and data reflected in the Contract Documents with respect to underground facilities at/or contiguous to the site are based upon information and data furnished to the Owner and the Engineer by the owners of such underground facilities or others, and the Owner does not assume any responsibility for the accuracy or completeness thereof including any damages whatsoever that may be incurred by the Bidder or the Contractor through his reliance thereon unless it is expressly provided otherwise in the Supplemental General Conditions and/or the Technical Specifications.

Before submitting a bid, the bidder shall conduct such examination, investigations, studies and tests as are necessary to satisfy himself as to: the nature and location of the physical conditions (surface, subsurface and underground facilities), the general and local conditions particularly those bearing upon transportation, disposal, handling and storage of materials, availability of labor, availability of utilities, local weather conditions, the character of equipment and facilities required preliminary to and during the prosecution of the work; any and all other conditions that may in any way affect the cost, progress, performance or furnishing of materials in accordance with the Contract Documents. All

INSTRUCTIONS TO BIDDERS

such examination, investigation, studies, tests and the like shall be at the Bidder's expense.

Upon reasonable request in advance, the Owner shall provide each Bidder access to the site to conduct such explorations, examination, investigation and tests as each Bidder may determine necessary for the submission of a Bid. The Bidder shall fill all holes, clean and restore the site to its former condition upon the completion of such activities.

The submission of a bid hereunder shall be considered prima facie evidence that the Bidder has made such examination as is set forth in the above paragraph and is knowledgeable as to the location and site conditions surrounding the work and the conditions to be encountered in performing the work and as to the requirements, conditions and terms of the Contract and Contract Documents.

The Owner assumes no responsibility for any understanding or representations made by any of its officers or agents during or prior to the execution of this Contract, for information contained in any reports, subsurface studies, or other information which may be made available for the Contractor's information and which are not included as Contract Documents, for any understanding or representations by the Owner or by others which are not expressly stated in the Contract Documents which liability is not expressly assumed by the Owner or its representatives or Engineer in the Contract Documents. Such information shall be deemed to be for the information of the Contractor and the Contractor shall have the obligation of evaluating any such information as to its accuracy and effect the Owner will not be liable or responsible for any such information or any conclusions that may be drawn there from by the Contractor.

The lands upon which the work is to be performed, right-of-ways and easements for access thereto together with other lands designated for use by the Contractor in performing the work are identified in the Contract Documents. All additional lands and access thereto that are 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.

The submission of a Bid shall constitute an incontrovertible representation by the Bidder that the Bidder has complied with every requirement of this Article, and that without exception the Bid is premised upon performing and furnishing the work required by the Contract Documents in compliance with such means, methods, techniques, sequences, or procedures of construction as may be indicated in or required by the Contract Documents; and that such means, methods, techniques, sequences or procedures described in the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing the work.

QUANTITIES OF WORK: The quantities of work or material stated in the Bid Schedule 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

INSTRUCTIONS TO BIDDERS

correspond therewith. The Owner reserves the right after award of the Contract to increase or decrease the quantities of any unit price item of the work by an amount up to and including 25 percent of the quantity of any bid item, or to omit portions of such work as may be deemed necessary or expedient by the Engineer or Owner, without a change in the unit price. Such right to revise and omit shall include the right to delete any bid item in its entirety, or to add additional bid items in quantities up to and including an aggregate total amount not to exceed 25 percent of the total amount of the Contract.

The Bidders nor the ultimate Contractor on the Project shall at any time after the submittal of a bid make or have any claim for damages or anticipated profits or loss of profit or otherwise because of any difference between the quantities of work actually done and material furnished and those stated in said unit price items of the Bid.

COMPETENCY OF BIDDERS: In selecting the lowest responsible Bidder, consideration will be given to the general competency of the Bidder for the performance of the work covered by the Bid. To this end, each bid shall be supported by a statement of the bidder's experience as of recent date on the form entitled "Information Required of Bidder," bound herein. No bid for the work will be accepted from a contractor who does not hold an active Contractor's license in good standing applicable to the type of work bid upon at the time of opening bids.

After an award of the contract no substitution of the Project Manager or Project Superintendent will be allowed without the written approval by the Owner.

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. Reasonable grounds for believing that any bidder is interested in more than one bid for the work contemplated will cause the rejection of all bids in which such bidder is interested. If there is reason for believing that collusion exists among the bidders, all bids will be rejected.

RETURN OF BID GUARANTEE: Within 10 calendar days after award of the contract, the Owner will return the bid guarantees accompanying such of the bids as are not considered in making the award. All other bid guarantees will be held until a Notice to Proceed has been issued and accepted. They will then be returned to the respective bidders whose bids they accompany.

EVALUATION OF BIDS: In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid or prior to the Notice of Award. In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents. Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

INSTRUCTIONS TO BIDDERS

AWARD OF CONTRACT: Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unqualified, unbalanced, or conditional Bids. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.

If Owner awards a contract for the Work, such award shall be to the qualified Bidder submitting the lowest responsive Bid. Any such award will be made by written notice and within 60 calendar days after opening of the bids, unless a different waiting period is expressly allowed in the Notice Inviting Bids. The Owner intends to award a single contract for construction of the Project. Individual schedules will not be awarded separately.

EXECUTION OF CONTRACT: The Bidder to whom the award is made shall secure all insurance and shall furnish all certificates and bonds required by the specifications within ten calendar days after receipt of the Notice of Award from the Owner. The Bidder to whom the award is made shall execute a written contract with the Owner on the form of agreement provided within ten calendar days after receipt of the Agreement from the Owner. Failure or refusal to enter into a contract 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 guarantee. If the successful bidder refuses or fails to execute the contract, the Owner may award the contract to the second lowest responsible bidder, or reject all bids and re-advertise the project for rebidding. If the second lowest responsible bidder refuses or fails to execute the contract, the Owner may award the contract to the third lowest responsible bidder. On the failure or refusal of such second or third lowest bidder to execute the contract, each such bidder's guarantees shall be likewise forfeited to the Owner.

ISSUANCE OF NOTICE TO PROCEED: The Owner intends to execute the Agreement and issue the Notice to Proceed specifying the Project start date within ten calendar days after its receipt of the executed Agreement, Purchase Order Assignment(s), (if applicable), bonds and insurance certificates from the successful bidder. If the Contract Time is expressed as a specific completion date in the Notice Inviting Bids and paragraph 3.1 of the Agreement rather than a specific number of successive days following the start date identified in the Notice to Proceed, then any delay by the Owner beyond the ten days in issuing the Notice to Proceed shall extend the completion date by the number of days of the delay.

LICENSES: Contractor must be licensed as a business qualified to do business within the state of Utah prior to issuance of a Notice of Award. Contractor must hold a current contractor's license with classifications appropriate to the work being contracted.

STATE REGISTRY: The Contractor shall register the project, if awarded, on the State of Utah Construction Registry prior to the commencement of the work.

BID

BID TO: JORDAN VALLEY WATER CONSERVANCY DISTRICT

The undersigned Bidder hereby proposes to furnish all plant machinery, labor, services, materials, equipment, tools, supplies, transportation, utilities, and all other items and facilities necessary to perform all work required under the Bidding Schedule of the Owner's Contract Documents entitled "3145 West 11400 South Pump Station Improvements" drawings and all addenda issued by said Owner prior to opening of the bids.

Addenda, if issued, are only delivered by e-mail to those on Owner's website (jvwcd.gov) Plan Holders List.

The undersigned bidder acknowledges receipt of the following addenda:

<u>No.</u>	<u>Date Received</u>	<u>No.</u>	<u>Date Received</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Bidder agrees that, within 10 calendar days after receipt of Notice of Award from Owner, he will execute the Agreement in the required form, of which the Notice Inviting Bids, Instructions to Bidders, Bid, Information Required of Bidder, Technical Specifications, Drawings, and all addenda issued by Owner prior to the opening of bids, are a part, and will secure the required insurance and bonds and furnish the required insurance certificates; and that upon failure to do so within said time, then the bid guarantee furnished by Bidder shall be forfeited to Owner as liquidated damages for such failure; provided, that if Bidder shall execute the Agreement, secure the required insurance and bonds, and furnish the required insurance certificates within said time, his check, if furnished, shall be returned to him within five days thereafter, and the bid bond, if furnished, shall become void. It is further understood that this bid may not be withdrawn for a period of 45 days after the date set for the opening thereof, unless otherwise required by law.

Dated: _____

Bidder: _____

By: _____
(Signature)

Title: _____

Bidder further agrees to complete all work required within the time stipulated in the Contract Documents, and to accept in full payment therefore the price(s) named in the above-mentioned Bidding Schedule(s).

BID

This Bid Schedule contains the schedule of prices which will be incorporated into the Agreement by reference. The determination of the low bidder will be based on Bid Schedule A.

BID SCHEDULE A

Item No.	Description	Quantity Unit	Unit Price	Amount
A1.	General Conditions Including Bidder's Insurance and Mobilization, Demobilization & Administration	LS		
A2.	Centrifugal Pumps and Motors	2 EA		
A3.	Ajustable Frequency Drives	2 EA		
A4.	All other Electrical Equipment	LS		
A5.	All Minor Piping, Valves and other Mechanical Items	LS		
A6.	Other Miscellaneous Items	LS		

Total Bid Schedule A: \$ _____

Bidder agrees to accept as full payment for Work proposed with the Bidding Documents based upon the undersigned's own estimate of quantities and costs and including sales, consumer, use, other taxes, and overhead and profit.

Bidder (Company name): _____

By: _____
(Signature)

Dated: _____

Name: _____

Title: _____

ATTACHMENTS TO THIS BID

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

1. Required Bid security in the form of Bid Bond.
2. Information Required of Bidder.

BID BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____
as Principal, and _____
as Surety, are held and firmly bound unto the Jordan Valley Water Conservancy District
(hereinafter called "Owner") in the sum of _____
dollars, (not less than five percent of the total amount of the bid) for the payment of which
sum, will and truly to be made, we bind ourselves, our heirs, executors, administrators,
successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, Principal has submitted a bid to Owner to perform all work required under
the bidding Schedule of the Owner's Contract Documents entitled "3145 West 11400
South Pump Station Improvements", (hereafter called the "Project").

NOW THEREFORE, if Principal is awarded Contract by Owner for the Construction of the
Project and, within the time and in the manner required under the heading "Instructions
to Bidders" enters into the written contract entitled "Agreement" bound with said Contract
Documents, furnishes the required certificates of insurance, and furnishes the required
Performance Bond and Payment Bond within 10 calendar days after receipt of such
contract from Owner, then this obligation shall be null and void, otherwise it shall remain
in full force and effect. In the event suit is brought upon this bond by Owner and judgment
is recovered, Surety shall pay all costs incurred by Owner in such suit, including a
reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this ___ day of _____, 20__.

By: _____

By: _____

President

Its: _____

Its: _____

(SEAL)

(SEAL)

INFORMATION REQUIRED OF BIDDER

The Bidder shall furnish the following information. Failure to comply with this requirement may render the Bid non-responsive and subject to rejection. Additional sheets shall be attached as required.

1. Contractor's name: _____
2. Contractor's address: _____

Contractor's Primary Contact: _____
Email address of Contractor's primary contact: _____
Contractor's telephone number: _____

3. Contractor must be qualified and licensed to do business in Utah.
Utah Department of Commerce Information
Business Entity Number: _____
Delinquent Date: _____
4. Contractor must hold a current contractor's license, classification E100.
Contractor's Utah License Number: _____
Expiration Date: _____
Primary Classification: _____
Supplemental Classification held, if any: _____

5. **Key Personnel Qualifications and Experience**
List key personnel here and provide detailed information in Attachments A and B. More than one Project Manager and/or Project Superintendent may be proposed. Only personnel approved by the Owner will be allowed in the key positions.

Project Manager A: _____
Project Manager (Alternate 1): _____
Project Manager (Alternate 2): _____

Project Manager shall have:

- At least five (5) years' construction experience
- Have successfully performed as Project Manager on the construction of at least two (2) pump installation projects, 100 HP or greater.

Project Superintendent A: _____
Project Superintendent (Alternate 1): _____
Project Superintendent (Alternate 2): _____

INFORMATION REQUIRED OF BIDDER

Project Superintendent shall have:

- At least ten (10) years' construction experience
- Three (3) projects with pump installation of 100 HP or greater
- One (1) project with the installation of a welded steel pressurized pipeline of at least 16-inches in diameter.

Note: One project may satisfy multiple requirements.

6. **Previous Contractor Project Experience**

Past project experience shall be provided for each requirement. The Owner shall be entitled to contact each, and every reference listed by the contractor. The Contractor, by submitting a bid, expressly agrees that any information concerning the CONTRACTORS in possession of said entities and references may be made available to the owner.

Provide the information identified in Attachment C for each project which meets the minimum requirements listed below:

Requirements:

Contractor shall have successfully completed at least three (3) projects which include pump installation of 100 HP or greater and at minimum one (1) project with the installation of a welded steel pressurized pipeline of at least 16-inches in diameter.

1.

2.

3.

4.

Note: One project may satisfy multiple requirements.

7. Number of persons employed full-time by the firm: _____

8. Name of person who inspected site of proposed work for your firm:

Name: _____

Date of Inspection: _____

INFORMATION REQUIRED OF BIDDER

9. Surety company who will provide the required bonds on this contract:

Agent's Name: _____

Telephone: _____

10. Workers Compensation Insurance Policy #: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT A

(Copy as necessary – recommended to provide more projects than required)

Project Manager Data Sheet

Name: _____

Years experienced as Project Manager: _____

Years of prior experience: _____ Positions: _____

Qualifying Project #1: _____

Project Summary: _____

Pump capacity & motor size: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #2: _____

Project Summary: _____

Pump capacity & motor size: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT B

(Copy as necessary – recommended to provide more projects than required)

Superintendent Data Sheet

Name: _____

Years experienced as Superintendent: _____

Years of prior experience: _____ Positions: _____

Qualifying Project #1: _____

Project Summary: _____

Pump capacity & motor size: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #2: _____

Project Summary: _____

Pump capacity & motor size: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #3: _____

Project Summary: _____

Pump capacity & motor size: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT C

(Copy as necessary – recommended to provide more projects than required)

Contractor Project Experience Summary

Project Name: _____

Project Location: _____

Project Manager: _____

Project Superintendent: _____

Project Description: _____

Pump capacity & motor size: _____

Date Bid: _____ Date Completed: _____

Contract bid price: _____ Contract final price: _____

Contract duration at bid: _____ Final contract duration: _____

Owner's contact information: _____

CONTRACTING REQUIREMENTS

CONTRACTING FORMS

AGREEMENT

An Agreement made as of the _____ day of _____, 20____, by and between the Jordan Valley Water Conservancy District, a Utah special district (“OWNER”), and **Contractor Name**, a **State** corporation qualified to do business and doing business in the State of Utah (“CONTRACTOR”).

TERMS:

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

ARTICLE I WORK

CONTRACTOR shall complete all Work as specified or indicated in the Contract Documents for the **project**. The description is as follows:

Furnishing all labor, services, materials, equipment, and supplies except for such materials, equipment, and services as may be stipulated in the Contract Documents to be furnished by the OWNER; furnishing and removing all plant machinery, temporary structures, tools, supplies, transportation, utilities, and all other items, facilities and equipment, and to do everything required by this Agreement and the Contract Documents; accepting all responsibility for and paying for all loss and damage arising out of the nature of the Work aforesaid, or from the action of the elements, or from any unforeseen difficulties which may arise during the prosecution of the Work until its acceptance by OWNER, and for all risks of every description connected with the Work; also for all expenses resulting from the suspension or discontinuance of work, except as in the Contract Documents are expressly stipulated to be borne by OWNER.

ARTICLE II ENGINEER

The Project has been designed by the OWNER. The OWNER will assume all duties and responsibilities and have the rights and authority assigned to the ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

[ALTERNATE PARAGRAPH] The Project has been designed by **Design Co Name**, a **State** corporation qualified to do business and doing business in the State of Utah, who is hereinafter called “ENGINEER” and who is to act as OWNER’s representative, assume all duties and responsibilities and have the rights and authority assigned to ENGINEER in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE III CONTRACT TIME

- 3.1 The Work shall be complete, in accordance with paragraphs 14.08 and 14.09 of the General Conditions, on or before **date**.
- 3.2 Liquidated Damages: OWNER and 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 paragraph 3.1 above, 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 or arbitration proceeding the actual loss suffered by the OWNER if the Work is not completed on time. Accordingly, instead of requiring any proof of loss, OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR will pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplementary General Conditions for each day that expires after the time specified in paragraph 3.1 for completion until the Work is substantially complete. And, after Substantial Completion if CONTRACTOR neglects, refuses or fails to complete the remaining Work within forty-five (45) days or any proper extension thereof granted by OWNER, CONTRACTOR shall pay OWNER the amount specified in Article 14.07 of the General Conditions and in Article 18.01 of the Supplemental General Conditions for each day that expires after the forty-five (45) days until readiness for final payment.

ARTICLE IV CONTRACT PRICE

All payments to the Contractor shall be made in accordance with the Contract Documents. OWNER shall pay CONTRACTOR for completion of the Work in accordance with the Contract Documents in the current funds, those prices stated in the approved Bid Schedule as named in the Notice of Award.

ARTICLE V PAYMENT PROCEDURES

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

- 5.1 Progress Payments: OWNER shall make progress payments on account of the Contract Price based on CONTRACTOR's Applications for Payment as recommended by ENGINEER, monthly. All progress payments will be based on the progress of the Work measured by the schedule of values established in the General Conditions (and in the case of Unit Price Work, based on the

number of units completed) or, in the event there is no schedule of values, as provided in the General Conditions.

- 5.2 Final Payment: Upon completion and acceptance of the Work in accordance with Article 14 of the General Conditions, OWNER shall pay the remainder of the Contract Price as recommended by ENGINEER as provided in Article 14.

ARTICLE VI INTEREST

All monies not paid when due as provided in Article 14 of the General Conditions shall bear interest at the rate of twelve percent (12%) per annum.

ARTICLE VII CONTRACTOR'S REPRESENTATION

To induce OWNER to enter into the Agreement, CONTRACTOR makes the following representations:

- 7.1 CONTRACTOR has familiarized itself with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance or furnishing of the Work.
- 7.2 CONTRACTOR has studied all exploration reports and tests of subsurface conditions and drawings of physical conditions which are identified in the Supplementary General Conditions, as provided in paragraph 4.02 of the General Conditions, and accepts the Technical Data contained in such reports and drawings upon which CONTRACTOR is entitled to rely.
- 7.3 CONTRACTOR has obtained and carefully studied (or assumes responsibility for obtaining and carefully studying) all such examinations, investigations, explorations, tests, reports and studies (in addition to or to supplement those referred to in paragraph 7.2 above) which pertain to the subsurface or physical conditions at or contiguous to the site or otherwise may affect the cost, progress, performance or furnishing of the Work as CONTRACTOR considers necessary for the performance or furnishing of the Work at the Contract Price, within the Contract Time and in accordance with the other terms and conditions of the Contract Documents, including specifically the provisions of paragraph 4.02 of the General Conditions; and no additional examinations, investigations, explorations, tests, reports, studies or similar information or data are or will be required by CONTRACTOR for such purposes.
- 7.4 CONTRACTOR has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground

Facilities at or contiguous to the site and assumes responsibility for the accurate location of said Underground Facilities.

- 7.5 CONTRACTOR has correlated the results of all observations, examinations, investigations, explorations, tests, reports, and studies with the terms and conditions of the Contract Documents.
- 7.6 CONTRACTOR has given ENGINEER written notice of all conflicts, errors, or discrepancies that are discovered in the Contract Documents, and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

ARTICLE VIII CONTRACT DOCUMENTS

The Contract Documents for the **project**, which comprise the entire agreement between OWNER and CONTRACTOR concerning the Work, consist of the following:

- 8.1 This Agreement;
- 8.2 Performance and Payment Bonds;
- 8.3 Notice of Award;
- 8.4 Notice to Proceed;
- 8.5 General Conditions;
- 8.6 Supplemental General Conditions;
- 8.7 Notice Inviting Bids;
- 8.8 Instructions to Bidders;
- 8.9 Information Required of Bidder;
- 8.10 Technical Specifications;
- 8.11 Drawings - Sheets number one through #;
- 8.12 Addendum number one **through #**; and,
- 8.13 CONTRACTOR's Bid, including all schedules and explanatory attachments, attached as Exhibit A.

The CONTRACTOR (1) acknowledges that he has received a copy of each document specified above, (2) acknowledges that he has read and understands each document specified above, and (3) agrees to every term, condition, and contract obligation set forth in each document specified above.

There are no Contract Documents other than those listed above in Article 8. The Contract Documents may only be amended, modified, or supplemented as provided in paragraph 3.03 of the General Conditions.

ARTICLE IX
FEDERAL REQUIREMENTS

The CONTRACTOR shall comply with federal regulations as stated in the Supplemental General Conditions, Article 21.

ARTICLE X
MISCELLANEOUS

- 10.1 Terms used in this Agreement that are defined in Article 1 of the General Conditions will have the meanings indicated in the General Conditions.
- 10.2 No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.
- 10.3 In the event any legal action or other proceeding is brought for the enforcement of this Agreement and/or the Contract Documents, or damages, because of an alleged dispute, breach, default or misrepresentation in connection with any of the provisions thereof, the successful or prevailing party shall be entitled to recover reasonable attorneys' fees and other costs incurred in the action or proceeding, in addition to any other relief to which it may be entitled.
- 10.4 Any notice to be given hereunder shall be deemed given when sent by registered or certified mail, postage prepaid, to the parties at their respective addresses stated below or at any other address when notice of such change of address has been given as provided in this Article 10.4.

[SIGNATURE PAGE FOLLOWS]

“OWNER”:

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088

“CONTRACTOR”

Name
Address
City, State Zip

Utah License No. 0000

By: Jacob C. Young
Its: General Manager/CEO

By: Name
Its: Title

EXHIBIT A
CONTRACTOR'S BID

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____, as Contractor, and as Surety, are held firmly bound unto the Jordan Valley Water Conservancy District hereinafter called "Owner," in the sum of \$_____ 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.

WHEREAS, Contractor has been awarded and is about to enter into the annexed Agreement with Owner to perform all work required under the Bidding Schedule(s) of the Owner's Contract Documents entitled "3145 West 11400 South Pump Station Improvements".

NOW THEREFORE, if Contractor shall perform all the requirements of the Agreement required to be performed on his 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 the Agreement, shall not in any way release Contractor or Surety thereunder, nor shall any extensions of the time granted under the provisions of the Agreement release either the Contractor or Surety, and notice of such alterations or extensions of the work, materials or time to complete made under the Agreement is hereby waived by Surety. This Bond is furnished in compliance and in accordance with 14-1-18, Utah Code Ann., as amended, and 63-56-38 Utah Code Ann., as amended.

SIGNED AND SEALED, this _____ day of _____, 20__.

By: _____

By: _____

Its: _____

Its: _____

(SEAL)

(SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS,

That _____ as Contractor, and as Surety, are held firmly bound unto the Jordan Valley Water Conservancy District hereinafter called "Owner," in the sum of \$_____ 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.

WHEREAS, Contractor has been awarded and is about to enter into the annexed Agreement with Owner to perform all work required under the Bidding Schedule(s) of the Owner's Contract Documents entitled, "3145 West 11400 South Pump Station Improvements".

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, a reasonable attorney's fee 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.

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 the Agreement, shall not in any way release Contractor or Surety thereunder, nor shall any extensions of time granted under the provisions of said contract release either Contractor or the Surety, and notice of such alterations or extensions of the work, materials or time to complete made under the Agreement is hereby waived by Surety. This bond is furnished in compliance and in accordance with 14-1-18 and 19 Utah Code Ann., as amended, and 63-56-38 Utah Code Ann., as amended.

SIGNED AND SEALED, this _____ day of _____, 20____.

By: _____

By: _____

Its:

Its:

(SEAL)

(SEAL)

(SEAL AND NOTARIAL ACKNOWLEDGMENT OF SURETY)

NOTICE OF AWARD

To: [Insert Contractor's Name and Address]

Re: 3145 West 11400 South Pump Station Improvements

You are hereby notified that the OWNER has accepted your bid for the above referenced project in the amount of \$_____.

Furnish the required Contractor's Performance Bond, Payment Bond and Certificates of Insurance within ten calendar days from the date of this notice to you. An acknowledged copy of this Notice of Award, together with all future correspondence regarding this project, shall be sent to the District's Project Manager: Kevin Rubow

When the Agreement is provided, sign and return it within ten calendar days from receipt of the agreement.

Dated this ____ day of _____, 20__.

Shane Swensen, P.E.
Director of Engineering

ACCEPTANCE OF NOTICE

Receipt of the above Notice of Award is hereby acknowledged by:

This _____ day of _____, 20__.

Signature: _____

Printed Name: _____

Title: _____

NOTICE TO PROCEED

To: [Insert Contractor's Name and Address]

Re: 3145 West 11400 South Pump Station Improvements

You are hereby notified to commence work in accordance with the Agreement dated _____, and you are to complete the work by, _____.

An acknowledged copy of this Notice to Proceed should be returned to the Owner, Attention: Kevin Rubow, Senior Engineer.

Dated this _____ day of _____.

Travis P. Christensen, P.E.
Engineering Group Leader

ACCEPTANCE OF NOTICE

Receipt of the above Notice to Proceed is hereby acknowledged by:

This _____ day of _____, 20____.

Signature: _____

Printed Name: _____

Title: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

PAYMENT APPLICATION AND CERTIFICATE No. ____ **DATE:** _____

SHEET ____ **OF** ____

PERIOD FROM _____ TO _____, 20__

PROJECT: 3145 West 11400 South Pump Station Improvements

JVWCD PROJECT NO.: 4373

CONTRACTOR: _____

ADDRESS: _____

ENGINEER:

JVWCD _____

1. ORIGINAL CONTRACT PRICE:..... \$ _____
2. NET CHANGE ORDERS APPROVED TO DATE: \$ _____
(Attach Summary Sheet)
3. REVISED CONTRACT AMOUNT: \$ _____
(Sum of Lines 1 & 2)
4. TOTAL VALUE OF WORK COMPLETED TO DATE \$ _____
(Attached Payment Breakdown)
5. PERCENT PROJECT COMPLETE: ____ %
(Divide Line 4 by 3 and multiply by 100)
6. LESS AMOUNT RETAINED (5%) \$ _____
7. MATERIALS ON HAND..... \$ _____
(95% of Value, Listing Attached)
8. SUBTOTAL (Sum of Lines 4, Line 6 and Line 7) \$ _____
9. LESS PREVIOUS PAYMENTS \$ _____
10. CURRENT PAYMENT DUE: \$ _____
(Line 8 & 9)

JORDAN VALLEY WATER CONSERVANCY DISTRICT

Payment Application and Certificate No _____ SHEET _____ OF _____

CONTRACTOR'S Certification:

The undersigned CONTRACTOR certifies that: (1) all previous progress payments received from OWNER on account of work done under the Contract referred to herein have been applied to discharge in full all obligations of CONTRACTOR incurred in connection with work covered by prior Applications for Payment numbered 1 through _____ inclusive; and, (2) title to all 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, claims, security interests and encumbrances (except such as covered by bond acceptable to OWNER).

Dated: _____ CONTRACTOR: _____

By: _____

Engineer's Recommendation:

This Application (with accompanying documentation) meets the requirements of the Contract Documents and payment of the amount due this application is recommended.

ENGINEER

Dated: _____
_____ Project Representative

Dated: _____
_____ Project Manager

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CHANGE ORDER

Change Order No. _____

Date: _____

Page ___ of ___

PROJECT NAME: 3145 West 11400 South Pump Station Improvements

PROJECT NUMBER: 4373

CONTRACTOR: _____

CONTRACT DATE: _____

The following changes are hereby made to the CONTRACT DOCUMENTS:

- 1)
- 2)
- 3)

Total Change to CONTRACT PRICE: \$

Original CONTRACT PRICE: \$

Current CONTRACT PRICE adjusted by previous CHANGE ORDER(S)..... \$

The new CONTRACT PRICE including this CHANGE ORDER will be \$

The CONTRACT TIME will be increased by _____ calendar days.

The date for Substantial Completion will be _____, 20__.

The Contractor agrees to furnish all labor and materials and perform all work as necessary to complete the change order items for the price named herein, which includes all supervision and miscellaneous costs. This change order constitutes full and mutual accord and satisfaction for all time and all costs related to this change. By acceptance of this change order the Contractor agrees that the change order represents an equitable adjustment to the Contract, and further agrees to waive all right to file a claim arising out of or as a result of this change. This document will become a supplement to the Contract, and all provisions will apply hereto, upon approval by the Owner.

JORDAN VALLEY WATER CONSERVANCY DISTRICT

**CHANGE ORDER
(CONTINUED)**

Change Order No. _____

Date: _____

Page ___ of ___

Recommended: _____
Engineer – Jacobs Engineering Date

Accepted: _____
Contractor – Date

Approved: _____
Owner - Jordan Valley Water Conservancy District Date

JORDAN VALLEY WATER CONSERVANCY DISTRICT

**CONTRACTOR'S CERTIFICATE
OF
SUBSTANTIAL COMPLETION**

OWNER

ENGINEER

TO: Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088-0070

Jacobs Engineering
6440 South Millrock Drive, Suite 300
Holladay, Utah 84121

PROJECT: 3145 West 11400 South Pump Station Improvements

ATTENTION: _____

FROM: _____
Firm or Corporation

This is to certify that I, _____ am an authorized official of working in the capacity of _____ and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been substantially performed and all materials used and installed to date are in accordance with, and in conformity to, the contract drawings and specifications. A list of all incomplete work is attached.

The Contractor hereby releases the Owner and its agents from all claims of and liability to the Contractor for anything done or furnished for or relating to the work, as further provided in Article 14.08B of the General Conditions, except demands against the Owner for the remainder of progress payments retained to date, and unresolved written claims prior to this date.

The contract work is now substantially complete, ready for its intended use, and ready for your inspection. You are requested to issue a Certificate of Substantial Completion.

SIGNATURE: _____

DATE: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

**CONTRACTOR'S CERTIFICATE
OF
FINAL COMPLETION**

OWNER

ENGINEER

TO: Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah 84088-0070

Jacobs Engineering
6440 Millrock Drive, Suite 300
Holladay, Utah 84121

PROJECT: 3145 West 11400 South Pump Station Improvements

ATTENTION: Project Representative: _____

FROM: _____
Firm or Corporation

This is to certify that I, _____ am an authorized official of _____ working in the capacity of _____ and have been properly authorized by said firm or corporation to sign the following statements pertaining to the subject contract:

I know of my own personal knowledge, and do hereby certify, that the work of the contract described above has been performed and all materials used and installed to date are in accordance with, and in conformity to, the contract drawings and specifications.

The Contract work is now complete in all parts and requirements, excepting the attached list of minor deficiencies and the reasons for each being incomplete to date, for which exemption from final payment requirements is requested in conformance to Article 14.09A of the General Conditions of our Contract (if no exemptions requested, write "none") _____. The work is now ready for your final inspection. The following items required from the Contractor prior to application for final payment (such as O & M Manuals, guarantees, record drawings, etc.) are submitted herewith, if any:

JORDAN VALLEY WATER CONSERVANCY DISTRICT

I understand that neither the issuance by the Engineer of a Notice of Completion, nor the acceptance thereof by the Owner, shall operate as a bar or claim against the Contractor under the terms of the guarantee provisions of the Contract Documents.

SIGNATURE: _____

DATE: _____

JORDAN VALLEY WATER CONSERVANCY DISTRICT

CONSENT OF SURETY FOR FINAL PAYMENT

PROJECT NAME: 3145 West 11400 South Pump Station Improvements

LOCATION: _____

TYPE OF CONTRACT: _____

AMOUNT OF CONTRACT: _____

In accordance with the provisions of the above-named contract between the Owner and the Contractor, the following named surety:

on the Payment Bond of the following named Contractor:

hereby approves of final payment to the Contractor, and further agrees that said final payment to the Contractor shall not relieve the Surety Company named herein of any of its obligations to the following named Owner (as set forth in said Surety company's bond):

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand and seal this day of _____, 20____.

(Name of Surety Company)

(Signature of Authorized Representative)

(Name of Authorized Representatives)

(Title)

JORDAN VALLEY WATER CONSERVANCY DISTRICT

AFFIDAVIT OF PAYMENT

To All Whom It May Concern:

WHEREAS, the undersigned has been employed by the Jordan Valley Water Conservancy District to furnish labor and materials under a contract dated _____ for the project entitled "3145 West 11400 South Pump Station Improvements", in the County of Salt Lake, State of Utah, of which Jordan Valley Water Conservancy District is the Owner.

NOW, THEREFORE, this _____ day of _____, 20____, the undersigned, as the Contractor for the above-named Contract pursuant to the Conditions of the Contract hereby certifies that, except as listed below, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or his property might in any way be held responsible.

EXCEPTIONS: (If none, write "None". If required by the Owner, the Contractor shall furnish bond satisfactory to the Owner for each Exception.)

Contractor (Name of sole ownership,
corporation or partnership)

(affix corporate seal here)

(Signature of Authorized Representative)

Title: _____

**GENERAL CONDITIONS OF THE
CONTRACT**

ARTICLE 1 - DEFINITIONS

Wherever used in these General Conditions or in the other Contract Documents 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.

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

Change Order - A document recommended by the ENGINEER, 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 - Information and Instructions, forms (including the Schedule of Prices and all required certificates and affidavits), Agreement, Performance Bond, Payment Bond, General Conditions, Supplemental General Conditions, Technical Specifications, Drawings and all Addenda and Change Orders executed pursuant to the provisions of the Contract Documents.

Contract Price - The total monies payable by the OWNER to the CONTRACTOR under the terms and conditions of the Contract Documents.

Contract Time - The number of successive Days stated in the Contract Documents for the 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.

Cost Proposal - The offer or proposal of the pipeline installation subcontractor to the CONTRACTOR to provide the work required under these Contract Documents.

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 ENGINEERS'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, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

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

Field Order - A written order issued by the ENGINEER which may or may not involve a change in the WORK.

Laws and Regulations; Laws or Regulations - Laws, rules, regulations, ordinances, codes, and/or orders promulgated by a lawfully constituted body authorized to issue such Laws and Regulations.

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 - The Jordan Valley Water Conservancy District.

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.

Project Representative - The authorized representative of the ENGINEER who is assigned to the site or any part thereof.

Proposer - Any person, firm or corporation submitting a proposal for the work.

Schedule of Prices - The offer or proposal of the CONTRACTOR setting forth the price or prices for the work to be performed.

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 at the site.

Substantial Completion - That state of construction when the WORK has progressed to the point where, in the opinion of the ENGINEER as evidenced by the Certificate 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 make 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 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 under ground 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 furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

GENERAL CONDITIONS

ARTICLE 2 - PRELIMINARY MATTERS

2.01 DELIVERY OF BONDS/INSURANCE CERTIFICATES

- A. The CONTRACTOR shall deliver to the OWNER the Agreement, Bonds, Insurance Policies and 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 5 copies of the Contract Documents, together with 5 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 ENGINEER any conflict, error, or discrepancy which the CONTRACTOR may discover and shall obtain a written interpretation or clarification from the ENGINEER before proceeding with any work affected thereby.
- B. The CONTRACTOR shall submit to the ENGINEER for review those documents called for in each section of the Technical Specifications.

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.

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2.06 FINALIZING SCHEDULES

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

GENERAL CONDITIONS

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, functionally complete, 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 ENGINEER in writing and before proceeding with the work affected thereby. The ENGINEER shall then make a written interpretation, clarification, or correction from the ENGINEER.

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3.02 ORDER OF PRECEDENCE OF CONTRACT DOCUMENTS

- A. In resolving conflicts resulting from conflicts, errors, or discrepancies in any of the Contract Documents, the order of precedence shall be as follows:
1. Change Orders
 2. Agreement
 3. Addenda
 4. Contractor's Bid (Bid Form)
 5. Supplemental General Conditions
 6. Notice Inviting Bids
 7. Instructions to Bidders
 8. General Conditions
 9. Technical Specifications
 10. Referenced Standard Specifications
 11. Drawings
- 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.

GENERAL 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 written consent.

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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 paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies exploration reports and subsurface conditions tests at the site that have been utilized by the ENGINEER 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 paragraph entitled "Physical Conditions" of the Supplementary General Conditions identifies 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 ENGINEER 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.

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4.03 DIFFERING SITE CONDITIONS

- A. The CONTRACTOR shall notify the ENGINEER 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 ENGINEER 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 differing 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 differing 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 ENGINEER will review the alleged differing site conditions, determine the necessity of obtaining additional explorations or tests with respect to verifying their existence and extent and advise the OWNER in writing of the ENGINEER's findings and conclusions.
- 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.

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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 or the ENGINEER by the owners of Underground Utilities or by others. Unless it is expressly provided in the Supplementary General Conditions and/or the Section entitled "Protection and Restoration of Existing Facilities" of the Technical Specifications, 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, the safeguard and protect the of 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 Contact 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 give written notice to the OWNER of that utility and the ENGINEER, specifying the location of the utility in question.

4.05 REFERENCE POINTS

- A. The ENGINEER 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 ENGINEER for alignment control. Unless otherwise specified in the Technical Specifications, 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.

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ARTICLE 5 - BONDS AND INSURANCE

5.01 PERFORMANCE AND OTHER BONDS

- A. The CONTRACTOR shall furnish Performance and Payment Bonds, each in the amount set forth in the Supplementary General Conditions as security for the faithful performance and payment of all the CONTRACTOR's obligations under the Contract Documents. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury's Circular 570, with an acceptable underwriting limitation limit. 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 ENGINEER 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.
- 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. All insurance companies, sureties, and bond companies shall have an AM Best rating of A- or better, with a Financial Size Category of XII or better. Sureties shall also be listed on the Department of the Treasury's Circular 570, with an acceptable underwriting limitation limit. 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 and ENGINEER 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

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notice has been given to the OWNER by certified mail. All insurance shall remain in effect until the ENGINEER issues the Notice of Completion and at all times thereafter when the CONTRACTOR may be correcting, removing, or replacing defective work in accordance with Paragraph 13.06 or completing punch list items required by the Notice of 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.

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

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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; and (c) uninsured 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, and 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.

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ARTICLE 6 - CONTRACTOR'S 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 through the ENGINEER.
- C. The CONTRACTOR's superintendent 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. When required in writing by the OWNER or ENGINEER, the CONTRACTOR or any subcontractor shall discharge any person who is, in the opinion of the OWNER or ENGINEER, incompetent, disorderly, or otherwise unsatisfactory and shall not again employ the discharged person on the WORK without the consent of the OWNER or ENGINEER. 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 the WORK, or property at the site or adjacent thereto, all work at the site shall be performed during regular working hours, and the CONTRACTOR will not permit overtime work or the performance of work on Saturday, Sunday or any legal holiday without the OWNER's written consent given after prior written notice

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to the ENGINEER. 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 ENGINEER in writing. Additional compensation will be paid the CONTRACTOR for overtime work in the event extra work is ordered by the ENGINEER 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 by 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 ENGINEER, 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 ENGINEER for acceptance in accordance with the provisions for "Contractor Submittals" in the Technical Specifications.

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6.04 SUBSTITUTES OR "OR-EQUAL" ITEMS

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to ENGINEER for review under the circumstances described below:
1. "Or-Equal" Items: If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by ENGINEER as an "or-equal" item, in which case review and approval of the proposed item may, in ENGINEER's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this paragraph 6.04.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment ENGINEER determines that: (i) it is a least equal in quality, durability, appearance, strength, and design characteristics; (ii) it will reliably perform at least equally well the function imposed by the design concept of the completed Project as a functioning whole, and;
 - b. CONTRACTOR certifies that: (i) there is no increase in cost to the OWNER; and (ii) it will conform substantially, even with deviations, to the detailed requirements of the item named in the Contract Document.
 2. Substitute Items
 - a. If in ENGINEER's sole discretion an item of material or equipment proposed by CONTRACTOR does not qualify as an "or-equal" item under paragraph 6.04.A.1, it will be considered a proposed substitute item.
 - b. CONTRACTOR shall submit sufficient information as provided below to allow ENGINEER to determine that the item of material or

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equipment proposed is essentially equivalent to that named and an acceptable substitute therefore. Requests for review of proposed substitute items of material or equipment will not be accepted by ENGINEER from anyone other than CONTRACTOR.

- c. The procedure for review by ENGINEER will be as set forth in paragraph 6.04.A.2.d, as supplemented in the Technical Specifications and as ENGINEER may decide is appropriate under the circumstances.
 - d. CONTRACTOR shall first make written application to ENGINEER for review of a proposed substitute item of material or equipment that CONTRACTOR seeks to furnish or use. The application shall certify that the proposed substitute item will perform adequately the functions and achieve the results called for by the general design, be similar in substance to that specified, and be suited to the same use as that specified. The application will state the extent, if any, to which the use of the proposed substitute item will prejudice CONTRACTOR's achievement of Substantial Completion on time, whether or not use of the proposed substitute item will require a change in any of the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) to adapt the design to the proposed substitute item, and whether or not incorporation or use of the substitute item is subject to payment of any license fee or royalty. All variations of the proposed substitute item from that specified will be identified in the application, and available engineering, sales, maintenance, repair, and replacement services will be indicated. The application will also contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change, all of which will be considered by ENGINEER in evaluating the proposed substitute item. ENGINEER may require CONTRACTOR to furnish additional data about the proposed substitute item.
- B. Substitute Construction Methods or Procedures: If a specific means, method, technique, sequence, or procedure of construction is shown or indicated in and expressly required by the Contract Documents, CONTRACTOR may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by ENGINEER. CONTRACTOR shall submit sufficient information to allow ENGINEER, in

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ENGINEER's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The procedure for review by ENGINEER will be similar to that provided in subparagraph 6.04.A.2.

- C. **Engineer's Evaluation:** ENGINEER will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to paragraphs 6.04.A and 6.04.B. ENGINEER will be the sole judge of acceptability. No "or-equal" or substitute will be ordered, installed or utilized until ENGINEER's review is complete, which will be evidenced by either a Change Order for a substitute or an approved Shop Drawing for an "or equal." ENGINEER will advise CONTRACTOR in writing of any negative determination.
- D. **Special Guarantee:** OWNER may require CONTRACTOR to furnish at CONTRACTOR's expense a special performance guarantee or other surety with respect to any substitute.
- E. **ENGINEER's Cost Reimbursement:** ENGINEER will record time required by ENGINEER and ENGINEER's Consultants in evaluating substitute proposed or submitted by CONTRACTOR pursuant to paragraphs 6.04.A.2 and 6.04.B and in making changes in the Contract Documents (or in the provisions of any other direct contract with OWNER for work on the Project) occasioned thereby. Whether or not ENGINEER approves a substitute item so proposed or submitted by CONTRACTOR, CONTRACTOR shall reimburse OWNER for the charges of ENGINEER and ENGINEER's Consultants for evaluation each such proposed substitute.
- F. **CONTRACTOR's EXPENSE:** CONTRACTOR shall provide all data in support of any proposed substitute or "or-equal" at CONTRACTOR's expense.

6.05 CONCERNING 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

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- 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 federal, state, and local laws, ordinances, codes, orders, 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 law, ordinance, code, order, or regulations, the CONTRACTOR shall report the same in writing to the ENGINEER. The CONTRACTOR shall indemnify, defend and hold harmless the OWNER, the ENGINEER and their officers, agents, and employees against all claims and from violation of any law, ordinance, code, order, or regulation, whether by CONTRACTOR or by its employees or subcontractors. Any particular law or regulation specified or

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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. Where an individual State act on occupational safety and health standards has been approved by Federal authority, then the provision of said State act shall control.

6.08 EQUAL OPPORTUNITY

- A. The Contractor agrees to abide by: the provisions of Title VII of the Civil Rights Act of 1964 (42USC § § 2000e et seq.), which prohibits discrimination against any employee or applicant for employment on the basis of race, religion, color, or national origin; Executive Order No. 11246, as amended, which prohibits discrimination on the basis of sex; 45 CFR 90, which prohibits discrimination on the basis of age; Section 504 of the Rehabilitation Act of 1973, (42 USC § 794), which prohibits discrimination on the basis of handicap; Utah Executive Order dated June 30, 1989, which prohibits sexual harassment in the workplace; and the Americans with Disabilities Act (42 USC § § 12111 et seq.), which prohibits discrimination against qualified employees and applicants with a disability.

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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 employees on the WORK and other persons and organizations who may be affected thereby.
 - 2. All the WORK and materials and equipment to be incorporated therein, whether in storage on or off the site; and

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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 duty shall be 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 Technical Specifications, the CONTRACTOR shall submit all shop drawings to the ENGINEER for review and approval in accordance with the approved schedule for shop drawings submittals specified in the Technical Specifications.
- B. The CONTRACTOR shall also submit to the ENGINEER for review and approval all samples in accordance with the approved schedule of sample submittals specified in the Technical Specifications.
- 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.

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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, 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 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 directly or indirectly from the negligence or carelessness of the CONTRACTOR or its 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, or by or on account of any act or omission of the CONTRACTOR or its agents;
 - 2. Liability or claims arising directly or indirectly from or based on the violation of any law, ordinance, regulation, order, or decree, whether by the CONTRACTOR or its agents;
 - 3. Liability or claims arising directly or indirectly from the use or manufacture by the CONTRACTOR, its agents, or the OWNER 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 directly or indirectly from the breach of any warranties, whether express or implied, made to the OWNER or any other parties by the CONTRACTOR or its agents;
 - 5. Liabilities or claims arising directly or indirectly from the willful misconduct of the CONTRACTOR or its agents; and,

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- 6. Liabilities or claims arising directly or indirectly from any breach of the obligations assumed herein by the CONTRACTOR.
- 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 ENGINEER, and shall be submitted to the ENGINEER at the conclusion of each work day.

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 interest 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.

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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 ENGINEER 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 ENGINEER 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 latent or nonapparent defects and deficiencies in the other work, 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.

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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.

GENERAL CONDITIONS

ARTICLE 8 - OWNER'S RESPONSIBILITIES

8.01 COMMUNICATIONS

- A. The OWNER shall issue all its communications to the CONTRACTOR through the ENGINEER.

8.02 PAYMENTS

- A. The OWNER shall make payments to the CONTRACTOR as provided in Paragraphs 14.05 and 14.09.

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 by the ENGINEER 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.

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.

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ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

9.01 OWNER'S REPRESENTATIVE

- A. The ENGINEER will be the OWNER's representative during the construction period. The duties, responsibilities and the limitations of authority of the ENGINEER as the OWNER's representative during construction are set forth in a separate agreement with the OWNER and 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 REPRESENTATION

- A. The ENGINEER will furnish a Project Representative to observe and inspect the performance of the WORK. The Project Representative and/or other authorized agents of the Engineer shall serve as the chief Owner/Engineer contact(s) with the Contractor during the construction phase. All submittals shall be delivered to and communications between the Engineer and the Contractor shall be handled by the Project Representative and/or other authorized agents. The Project Representative shall be the chief authorized representative of the Owner and the Engineer at the site of the work in all on-site relations with the Contractor.

9.04 CLARIFICATIONS AND INTERPRETATIONS

- A. The ENGINEER 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 ENGINEER 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 ENGINEER may authorize minor variation 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

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CONTRACTOR believes that a Field Order justifies an increase in the Contract Price or an extension of the Contract Time and parties are unable to agree as the amount or extent thereof, the CONTRACTOR may make a claim therefor as provided in Article 11 or 12.

9.06 REJECTION OF DEFECTIVE WORK

- A. The ENGINEER is authorized to reject work which the ENGINEER 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 ENGINEER 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 Technical Specifications.
- B. In connection with the ENGINEER's responsibilities as to Change Orders, see Articles 10, 11, and 12.
- C. In connection with the ENGINEER's responsibilities with respect to Applications for Payment, see Article 14.

9.08 DECISIONS ON DISPUTES

- 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 ENGINEER in writing with a request for formal decision in accordance with this paragraph. The ENGINEER 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 ENGINEER promptly (but in no event later than 30 days) after the occurrence of the event. Written supporting data will be submitted to the ENGINEER with the written claim unless the ENGINEER allows an additional period of time to ascertain more accurate data in support of the claim.
- B. When reviewing the claim or dispute, the ENGINEER 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 ENGINEER's 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

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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. Neither the ENGINEER's authority to act pursuant to its agreement with the OWNER, nor the description of that authority under this Article 9, nor any other description of the ENGINEER's responsibility in the Contract Documents, nor any decision made by the ENGINEER in good faith either to exercise or not exercise its authority, shall give rise to any duty or responsibility on the part of the ENGINEER to the CONTRACTOR, any Subcontractor, any Supplier, any surety or any other person or organization performing any part of the WORK.
- B. 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 judgement of the ENGINEER as to the WORK, it is intended that such requirement, direction, review, or judgment will be solely to evaluate the WORK for compliance with the Contract Documents, unless there is a specific statement indicating otherwise. The use of any such term or adjective shall not be effective to assign to the ENGINEER any duty or authority to supervise or direct the performance of the WORK or any duty or authority to undertake responsibility contrary to the provisions of its agreement with the OWNER.
- C. The ENGINEER will not be responsible for the CONTRACTOR's means, methods, techniques, sequences, or procedures of construction not specified in the Contract Documents or the safety precautions and programs incident thereto.
- D. The ENGINEER will not 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.

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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 ENGINEER. 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 or 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.
- 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.

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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. Changes in the quantity of all bid items established in the Contract Documents, regardless of whether the changes are more or less than 25 percent and at the unit price established in the Contract Documents or adjusted otherwise, shall be documented by Change Orders.

- 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.

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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 ENGINEER 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 ENGINEER 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 ENGINEER 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 11.01B.

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

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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 ENGINEER 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.

At the beginning of the extra work and as later requested by the ENGINEER, the CONTRACTOR shall furnish the ENGINEER 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 ENGINEER. Markup except for actual costs incurred in the handling of such materials will not be allowed.

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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 ENGINEER 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 Supplementary General Conditions. 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. If it is deemed necessary by the CONTRACTOR to use equipment not listed in the Supplementary General Conditions an equitable rental rate for the equipment will be established by the ENGINEER. The CONTRACTOR may furnish cost data which might assist the ENGINEER in the establishing the rental rate.
1. All equipment shall, in the opinion of the ENGINEER, 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 ENGINEER, 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.

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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.

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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 ENGINEER in making estimates for payment for special services:
 1. When the ENGINEER 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 termination of market values by the ENGINEER, 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.

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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 ENGINEER, 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:

ACTUAL NECESSARY COST 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 the subcontractor, the allowance specified herein shall be applied to the labor, materials, and equipment costs of the subcontractor, to which the CONTRACTOR may add 5 percent of the subcontractor's total cost for the extra work. Regardless of the number of hierarchical tiers of subcontractors, the 5 percent increase above the subcontractor's total cost which includes the allowances for overhead and profit specified herein may be applied one time only for each separate work transaction.

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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 ENGINEER 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 ENGINEER 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. All claims for adjustment in the Contract Time shall be determined by the ENGINEER in accordance with Paragraph 9.08 if the OWNER 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 12.01A.

- 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 ENGINEER 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 15.01 (a) or for whatever other reasons including the stoppage of work by the ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

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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 paragraph entitled "Inclement weather delays" of 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 time named in the Contract Documents for the completion of the WORK, 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 ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay. The ENGINEER 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, accidents, failure on the part of the CONTRACTOR to carry out the provisions of the Contract 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. In the event that Contract completion is delayed beyond the Contract Time named in the Specifications by reason of shortages of raw materials required for CONTRACTOR-furnished items, the CONTRACTOR shall be entitled to

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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 and ENGINEER 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, to offset the expected delay. The CONTRACTOR shall notify the ENGINEER, 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 acting through the ENGINEER, and his findings thereon shall be based on the ENGINEER'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 reason of changes made under the provisions of Article 10 or changed conditions as provided under Article 4.03, or by failure of the OWNER to acquire or clear right-of-way as provided under Article 15.01, or by any act of the ENGINEER or of the OWNER, not contemplated by the Contract, 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, except, that if the WORK is increased as a result of changes, the OWNER, at his sole discretion, may grant an adjustment in the number of calendar days for completion of the Contract. In the event of such delay, the CONTRACTOR shall notify the ENGINEER in writing of the causes of delay within 15 calendar days from the beginning of any such delay.

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

13.01 WARRANTY, GUARANTEE AND MAINTENANCE 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. 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 Engineer's Notice of 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 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.

GENERAL CONDITIONS

13.03 TESTS AND INSPECTIONS

- A. The CONTRACTOR shall give the ENGINEER 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 or the ENGINEER's acceptance of a Supplier of materials or equipment proposed as a substitution 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 ENGINEER will make, or have made, such inspections and test as the ENGINEER deems necessary to see that the WORK is being accomplished in accordance with the requirements of 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 or the OWNER-ENGINEER Agreement, 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 ENGINEER, as well as the cost of subsequent re-inspection and retesting. Neither observations by the ENGINEER 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.

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- E. If any work (including the work of others) that is to be inspected, tested, or approved is covered without the ENGINEER's written authorization, it must, if requested by the ENGINEER, be uncovered for testing, inspection, and observation. The uncovering shall be at the CONTRACTOR's expense unless the CONTRACTOR timely notified the ENGINEER of the CONTRACTOR's intention to cover the same and the ENGINEER failed to act with reasonable promptness in response to the notice.
- F. In any work is covered contrary to the written request of the ENGINEER, it must, if requested by the ENGINEER, be uncovered for the ENGINEER's observation and replaced at the CONTRACTOR's expense.
- G. If the ENGINEER considers it necessary or advisable that covered work be observed, inspected or tested by the ENGINEER or others, the ENGINEER 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 ENGINEER's direction and furnish all necessary labor, material, and equipment. If found 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 ENGINEER, the CONTRACTOR shall promptly correct all defective work, whether or not fabricated, installed, or completed, or, if the

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work has been rejected by the ENGINEER, 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.

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.

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ARTICLE 14 - PAYMENTS TO CONTRACTOR, LIQUIDATED DAMAGES AND COMPLETION

14.01 SCHEDULE OF VALUES (LUMP SUM PRICE BREAKDOWN)

- A. The schedule of values or lump sum price breakdown established as provided in the Technical Specifications shall serve as the basis for progress payments and will be incorporated into the form of Application for Payment included in the Contract Documents.

14.02 UNIT PRICE BID SCHEDULE

- A. Progress payments for unit price work 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 ENGINEER 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 Value of Materials at the Site which have not yet been incorporated in the WORK, and less a deductive adjustment for materials installed which were not previously incorporated in the WORK, but for which payment was allowed under the provisions of payment for Materials Stored at the Site but not yet 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 withhold and retain 5% of each approved progress payment to the CONTRACTOR. The total retention proceeds withheld shall not exceed 5% of the total construction price. All retention proceeds shall be placed by the OWNER in an interest-bearing account. The interest accrued shall be for the benefit of the CONTRACTOR and its subcontractors, and it shall be paid after the WORK has been completed and accepted by the OWNER. CONTRACTOR shall ensure that any interest accrued on the

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retainage is distributed by the CONTRACTOR to its subcontractors on a pro rata basis.

- E. Any retention proceeds withheld, and any accrued interest, shall be released by the OWNER pursuant to an Application for Payment from the CONTRACTOR within 45 days from the later of:
1. the date the OWNER receives the final Application for Payment from the CONTRACTOR;
 2. the date that a certificate of occupancy or final acceptance notice is issued to:
 - (a) the Contractor who obtained the building permit from the building inspector or from a public agency;
 - (b) the OWNER; or
 - (c) the ENGINEER.
 3. the date the CONTRACTOR accepts final payment for the Work; or
 4. the date that a public agency or building inspector having authority to issue its own certificate of occupancy does not issue the certificate but permits partial or complete occupancy of a newly constructed or remodeled building; provided, however, that if only partial occupancy of a building is permitted, any retention proceeds withheld and retained, and any accrued interest, shall be partially released in direct proportion to the value of the part of the building occupied.

Each Application for Payment from the CONTRACTOR shall include documentation of lien releases or waivers.

- F. Notwithstanding any other provision in this Article to the contrary,
1. If the CONTRACTOR is in default or breach of the terms and conditions of the Contract Documents, the OWNER may withhold from payment to the CONTRACTOR for so long as reasonably necessary an amount necessary to cure the breach or default of the CONTRACTOR; or
 2. If the WORK or a portion of the WORK has been substantially completed, the OWNER may retain until completion up to twice the

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fair market value of the WORK of the CONTRACTOR that has not been completed:

- (a) in accordance with the Contract Documents; or
 - (b) in the absence of applicable provisions in the Contract Documents to generally accepted craft standards.
3. If the OWNER refuses payment under subparagraphs (F)(i) or (ii), it shall describe in writing within 45 days of withholding such amounts what portion of the WORK was not completed according to the standards specified in the Contract Documents.
- G. The CONTRACTOR shall distribute retention proceeds as outlined below:
1. Except as provided in Paragraph 14.03.G.2, below, if the CONTRACTOR receives retention proceeds, it shall pay each of its subcontractors from whom retention has been withheld each subcontractor's share of the retention received within ten days from the day that all or any portion of the retention proceeds is received from the OWNER.
 2. Notwithstanding Paragraph 14.03.G.1, above, if a retention payment received by the CONTRACTOR is specifically designated for a particular subcontractor, payment of the retention shall be made to the designated subcontractor.
- H. 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 \$5,000 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 in these General Conditions 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.

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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 ENGINEER 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 ENGINEER's reasons for refusing to recommend payment. In the later case, the CONTRACTOR may make the necessary corrections and resubmit the Application. Thirty 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.
- B. The OWNER may refuse to make payment of the full amount recommended by the ENGINEER 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 (with a copy to the ENGINEER) 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 ENGINEER 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,

GENERAL CONDITIONS

heat, utilities and insurance. Upon the OWNER's acceptance of these recommendations, the ENGINEER's aforesaid recommendation will be binding on the OWNER and the CONTRACTOR until final payment.

- 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 LIQUIDATED DAMAGES

- A. The CONTRACTOR shall pay to the OWNER the amount specified in the Supplemental 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 time or times agreed upon. The periods for which these damages shall be paid shall be the number of Days from the agreed date or 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 ENGINEER certifies Substantial Completion of WORK or specified parts of the WORK 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 Supplemental 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. Said damages are not in lieu of but in addition to other actual or consequential damages to which the OWNER may be entitled.
- C. 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, and the CONTRACTOR has delivered to the ENGINEER all maintenance and operating instructions, schedules, guarantees, bonds, certificates of

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inspection, marked-up record documents and other documents, all as required by the Contract Documents, the CONTRACTOR may notify the OWNER and the ENGINEER in writing that the WORK is substantially complete and request that the ENGINEER prepare a Certificate of Substantial Completion. Within a reasonable time thereafter, the OWNER, the CONTRACTOR, and the ENGINEER shall make an inspection of the WORK to determine the status of completion. If the ENGINEER does not consider the WORK substantially complete, the ENGINEER will notify the OWNER and CONTRACTOR in writing giving the reasons therefor. If the ENGINEER considers the WORK substantially complete, the ENGINEER will prepare and deliver to the OWNER for its execution the Certificate of Substantial Completion signed by the ENGINEER and CONTRACTOR, which shall fix the date of Substantial Completion.

- B. The Certificate 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 Certificate of Substantial Completion, the ENGINEER 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 ENGINEER's 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.

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14.09 COMPLETION AND FINAL PAYMENT

- A. Upon written certification from the CONTRACTOR that the WORK is complete (if a Certificate of Substantial Completion has been issued this certification must occur within 45 days of that date), the ENGINEER will make a final inspection with the OWNER and the CONTRACTOR. If the OWNER and ENGINEER do not consider the WORK complete, the ENGINEER will notify the OWNER and 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 ENGINEER and OWNER consider 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 ENGINEER 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 ENGINEER's Notice of 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 ENGINEER and delivered to the ENGINEER all required additions and modifications to 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 ENGINEER 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 or ENGINEER 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.

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14.10 FINAL APPLICATION FOR PAYMENT

- A. If, on the basis of the ENGINEER's observation of the WORK during construction and final inspection, and the ENGINEER's review of the final application for payment and accompanying documentation, all as required by the Contract Documents, the ENGINEER is satisfied that the WORK has been completed and the CONTRACTOR has fulfilled all of his obligations under the Contract Documents, the ENGINEER 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 ENGINEER will give written notice to the OWNER and the CONTRACTOR that the WORK is acceptable by executing the ENGINEER's Notice of Completion. Otherwise, the ENGINEER 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 ENGINEER's filing of the Notice of Completion, the OWNER will make final payment including all deducted retainage (except as noted below) 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 damages, as applicable.
 2. All amounts retained by the OWNER under Paragraph 14.03(F).

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 ENGINEER, nor the issuance of a Certificate 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.

GENERAL CONDITIONS

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 Certificate of Substantial Completion.

GENERAL CONDITIONS

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

15.01 SUSPENSION OF WORK BY OWNER

- A. The OWNER acting through the ENGINEER 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 ENGINEER of written notice to proceed. Whenever the OWNER temporarily suspends work for any conditions enumerated in this Article 15.01 A, 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 the written order suspending the work and shall be terminated upon receipt by the Contractor of the written order terminating the suspension.
- C. 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 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 ENGINEER for the CONTRACTOR's failure to comply with any order issued by the ENGINEER.

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 ENGINEER's

GENERAL CONDITIONS

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 engineer, 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 ENGINEER 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

GENERAL CONDITIONS

CONTRACTOR any monies due him in accordance with the terms or the Contract Documents and within 60 days after presentation to the OWNER by the CONTRACTOR of a request therefor, 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.

GENERAL CONDITIONS

ARTICLE 16 - MISCELLANEOUS

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 ASBESTOS

- A. If the CONTRACTOR during the course of work observes the existence of asbestos in any structure or building, the CONTRACTOR shall promptly notify the OWNER and the ENGINEER. The OWNER shall consult with the ENGINEER regarding removal or encapsulation of the asbestos material and the CONTRACTOR shall not perform any work pertinent to the asbestos material prior to receipt or special instruction from the OWNER through the ENGINEER.

**SUPPLEMENTAL GENERAL
CONDITIONS**

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 17 - GENERAL

17.01 GENERAL

1. These Supplemental General Conditions amend or supplement the General Conditions of the Contract and any other provisions of the Contract Documents as indicated herein. All provisions which are not so amended or supplemented remain in full force and effect.
2. The terms used in these Supplemental General Conditions which are defined in the General Conditions of the Contract have the meanings assigned to them in the General Conditions of the Contract herein.

17.02 SUPPLEMENTAL DEFINITIONS

1. ENGINEER

The "Engineer" is

Jacobs Engineering
6440 South Millrock Drive, Suite 300
Holladay, UT 84121
Office: (385) 474-8564
Contact: Ryan Willeitner, P.E.
Email: ryan.willeitner@jacobs.com

17.03 TESTING COSTS

Paragraph 13.03 of the General Conditions is amended as follows: the CONTRACTOR shall pay all testing costs as outlined in Specification Section 01 45 16.13, Contractor Quality Control, and the individual specifications sections of the Contract Documents. The Owner reserves the right to have additional tests performed by a testing organization selected by the OWNER and at the OWNER's expense.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 18 - AMOUNTS OF LIQUIDATED DAMAGES, BONDS AND INSURANCE

18.01 AMOUNT OF LIQUIDATED DAMAGES

- A. As provided in Article 14.07 of the General Conditions, the Contractor shall pay to the Owner as liquidated damages the amount of \$1,000 for each calendar day's delay beyond the Contract Time for substantial completion, liquated damages shall apply to each site stipulated in the Contract Documents. The Contractor shall pay to the Owner as liquidated damages the amount of \$200 for each calendar day's delay beyond 45 calendar days from the date of substantial Completion until the Engineer issues the Notice of Final Completion.

18.02 PERFORMANCE AND OTHER BOND AMOUNTS

- A. 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.

18.03 INSURANCE AMOUNTS

The limits of liability for the insurance required by Paragraph 5.02 of the General Conditions shall provide for not less than the following amounts or greater where required by Laws and Regulations:

- A. Workers' Compensation under Paragraph 5.02B.1 of the General Conditions:

- 1. State: Utah Statutory

- B. Comprehensive General Liability: (under Paragraph 5.02B.2 of the General Conditions):

- 1. Bodily Injury (including completed operations and products liability):

<u>\$ 500,000</u>	Each Occurrence
<u>\$ 1,000,000</u>	Annual Aggregate

Property Damage:

<u>\$ 500,000</u>	Each Occurrence
<u>\$ 1,000,000</u>	Annual Aggregate
or a combined single limit of	<u>\$1,000,000</u>

SUPPLEMENTAL GENERAL CONDITIONS

2. Property Damage liability insurance including, Explosion, Collapse and Underground coverages, where applicable.

3. Personal Injury, with employment exclusion deleted

\$ 1,000,000

Annual Aggregate

C. Comprehensive Automobile Liability: (Under Paragraph 5.02B.3 of the General Conditions:)

1. Bodily Injury

\$ 500,000

Each Person

\$ 1,000,000

Each Occurrence

2. Property Damage:

\$ 500,000

Each Occurrence

or combined single limit of

\$1,000,000

D. Builders Risk: Not required.

18.04 ADDITIONAL INSURED

Following Paragraph 5.02 of the General Conditions, the Contractor shall include the following parties or entities as additional insured:

A. Jordan Valley Water Conservancy District
8215 South 1300 West, West Jordan, Utah 84088

B. Jacobs Engineering
6440 South Millrock Drive, Suite 300, Holladay, Utah 84121

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 19 - PHYSICAL CONDITIONS AND WEATHER DELAYS

19.01 INCLEMENT WEATHER DELAYS

- A. The Contractor's construction schedule shall be based upon the inclusion of at least five (5) day(s) of inclement weather delays. Reference Article 12, paragraph 12.02 of the General Conditions for additional requirements.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 20 - SUBCONTRACT LIMITATIONS

20.01 SUBCONTRACT LIMITATIONS

- A. In addition to the provisions of Paragraph 6.05 of the General Conditions, the CONTRACTOR shall perform not less than 20 percent of the WORK with its own forces (i.e., without subcontracting). The 20 percent requirement shall be understood to refer to the WORK, the value of which totals not less than 20 percent of the Contract Price.

SUPPLEMENTAL GENERAL CONDITIONS

ARTICLE 21 - MISCELLANEOUS

21.01 PATENTS AND COPYRIGHTS

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.

SPECIFICATIONS

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 PROPOSAL REQUESTS

- A. Owner may, in anticipation of ordering an addition, deletion, or revision to the Work, request Contractor to prepare a detailed proposal of cost and times to perform contemplated change.
- B. Proposal request will include reference number for tracking purposes and detailed description of and reason for proposed change, and such additional information as appropriate and as may be required for Contractor to accurately estimate cost and time impact on Project.
- C. Proposal request is for information only; Contractor is neither authorized to execute proposed change nor to stop Work in progress as result of such request.
- D. Contractor's written proposal shall be transmitted to Engineer promptly, but not later than 14 days after Contractor's receipt of Owner's written request. Proposal shall remain firm for a maximum period of 45 days after receipt by Engineer.
- E. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a Claim for an adjustment in Contract Price or Contract Times (or Milestones).

1.02 CLAIMS

- A. Include, at a minimum:
 - 1. Specific references including (i) Drawing numbers, (ii) Specification section and article/paragraph number, and (iii) Submittal type, Submittal number, date reviewed, Engineer's comment, as applicable, with appropriate attachments.
 - 2. Stipulated facts and pertinent documents, including photographs and statements.
 - 3. Interpretations relied upon.
 - 4. Description of (i) nature and extent of Claim, (ii) who or what caused the situation, (iii) impact to the Work and work of others, and (iv) discussion of claimant's justification for requesting a change to price or times or both.

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5. Estimated adjustment in price claimant believes it is entitled to with full documentation and justification.
6. Requested Change in Contract Times: Include at least (i) Progress Schedule documentation showing logic diagram for request, (ii) documentation that float times available for Work have been used, and (iii) revised activity logic with durations including sub-network logic revisions, duration changes, and other interrelated schedule impacts, as appropriate.
7. Documentation as may be necessary as set forth below for Work Change Directive, and as Engineer may otherwise require.

1.03 WORK CHANGE DIRECTIVES

A. Procedures:

1. Engineer will:
 - a. Initiate, including a description of the Work involved and any attachments.
 - b. Affix signature, demonstrating Engineer's recommendation.
 - c. Transmit three copies to Owner for authorization.
2. Owner will:
 - a. Affix signature, demonstrating approval of the changes involved.
 - b. Return two copies to Engineer, who will retain one copy, and forward one copy to Contractor.
3. Upon completion of Work covered by the Work Change Directive or when final Contract Times and Contract Price are determined, Contractor shall submit documentation for inclusion in a Change Order.
4. Contractor's documentation shall include but not be limited to:
 - a. Appropriately detailed records of Work performed to enable determination of value of the Work.
 - b. Full information required to substantiate resulting change in Contract Times and Contract Price for Work. On request of Engineer, provide additional data necessary to support documentation.
 - c. Support data for Work performed on a unit price or Cost of the Work basis with additional information such as:
 - 1) Dates Work was performed, and by whom.
 - 2) Time records, wage rates paid, and equipment rental rates.
 - 3) Invoices and receipts for materials, equipment, and subcontracts, all similarly documented.

- B. Effective Date of Work Change Directive: Date of signature by Owner, unless otherwise indicated thereon.

1.04 CHANGE ORDERS

A. Procedure:

1. Engineer will prepare a digital copy of proposed Change Order and transmit such with Engineer's written recommendation and request to Contractor for signature.
2. Contractor shall, upon receipt, either: (i) promptly sign copies, retaining one for its file, and return remaining copies to Engineer for Owner's signature, or (ii) return unsigned copies with written justification for not executing Change Order.
3. Engineer will, upon receipt of Contractor signed copies, promptly forward Engineer's written recommendation and partially executed five copies for Owner's signature, or if Contractor fails to execute the Change Order, Engineer will promptly so notify Owner and transmit Contractor's justification to Owner.
4. Upon receipt of Contractor-executed Change Order, Owner will promptly either:
 - a. Execute Change Order, retaining one copy for its file and returning four copies to Engineer.
 - b. Return to Engineer unsigned copies with written justification for not executing Change Order.
5. Upon receipt of Owner-executed Change Order, Engineer will transmit two copies to Contractor and retain one copy, or if Owner fails to execute the Change Order, Engineer will promptly so notify Contractor and transmit Owner's justification to Contractor.
6. Upon receipt of Owner-executed Change Order, Contractor shall:
 - a. Perform Work covered by Change Order.
 - b. Revise Schedule of Values to adjust Contract Price and submit with next Application for Payment.
 - c. Revise Progress Schedule to reflect changes in Contract Times, if any, and to adjust times for other items of Work affected by change.
 - d. Enter changes in Project record documents after completion of change related Work.

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- B. In signing a Change Order, Owner and Contractor acknowledge and agree that:
1. Stipulated compensation (Contract Price or Contract Times, or both) set forth includes payment for (i) the Cost of the Work covered by the Change Order, (ii) Contractor's fee for overhead and profit, (iii) interruption of Progress Schedule, (iv) delay and impact, including cumulative impact, on other Work under the Contract Documents, and (v) extended overheads.
 2. Change Order constitutes full mutual accord and satisfaction for the change to the Work.
 3. Unless otherwise stated in the Change Order, all requirements of the original Contract Documents apply to the Work covered by the Change Order.

1.05 FIELD ORDER

- A. Engineer will issue Field Orders, with three copies to Contractor.
- B. Effective date of the Field Order shall be the date of signature by Engineer, unless otherwise indicated thereon.
- C. Contractor shall acknowledge receipt by signing and returning one copy to Engineer.
- D. Field Orders will be incorporated into subsequent Change Orders, as a no-cost change to the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

**SECTION 01 29 00
PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SUBMITTALS

- A. Informational Submittals:
 - 1. Schedule of Values: Submit on Contractor's standard form.
 - 2. Schedule of Estimated Progress Payments:
 - a. Submit with initially acceptable Schedule of Values.
 - b. Submit adjustments thereto with Application for Payment.
 - 3. Application for Payment.
 - 4. Final Application for Payment.

1.02 SCHEDULE OF VALUES

- A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.
- B. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.
- C. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.
- D. Lump Sum Work:
 - 1. Reflect schedule of values format included in the bid form, allowances and alternates, as applicable.
 - 2. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.
 - 3. Break down by Division 02 through Division 49.
 - 4. Lump Sum items shall be broken down into individual items and components such that the cost of each item is no larger than 20,000 dollars unless agreed upon otherwise with the Engineer.

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- E. An unbalanced or front-end loaded schedule will not be acceptable.
- F. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.
- G. Submit Schedule of Values in a spreadsheet format compatible with latest version of Excel.

1.03 SCHEDULE OF ESTIMATED PROGRESS PAYMENTS

- A. Show estimated payment requests throughout Contract Times aggregating initial Contract Price.
- B. Base estimated progress payments on initially acceptable progress schedule. Adjust to reflect subsequent adjustments in progress schedule and Contract Price as reflected by modifications to the Contract Documents.

1.04 APPLICATION FOR PAYMENT

- A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.
- B. Use detailed Application for Payment Form provided by Owner.
- C. Provide separate form for each schedule as applicable.
- D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.
- E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.
- F. Preparation:
 - 1. Round values to nearest dollar.
 - 2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.05 MEASUREMENT—GENERAL

- A. Weighing, measuring, and metering devices used to measure quantity of materials for Work shall be suitable for purpose intended and conform to tolerances and specifications as specified in National Institute of Standards and Technology, Handbook 44.
- B. Whenever pay quantities of material are determined by weight, material shall be weighed on scales furnished by Contractor and certified accurate by state agency responsible. Weight or load slip shall be obtained from weigher and delivered to Owner's representative at point of delivery of material.
- C. If material is shipped by rail, car weights will be accepted provided that actual weight of material only will be paid for and not minimum car weight used for assessing freight tariff, and provided further that car weights will not be acceptable for material to be passed through mixing plants.
- D. Vehicles used to haul material being paid for by weight shall be weighed empty daily and at such additional times as required by Engineer. Each vehicle shall bear a plainly legible identification mark.
- E. Materials that are specified for measurement by the cubic yard measured in the vehicle shall be hauled in vehicles of such type and size that actual contents may be readily and accurately determined. Unless all vehicles are of uniform capacity, each vehicle must bear a plainly legible identification mark indicating its water level capacity. Vehicles shall be loaded to at least their water level capacity. Loads hauled in vehicles not meeting above requirements or loads of a quantity less than the capacity of the vehicle, measured after being leveled off as above provided, will be subject to rejection, and no compensation will be allowed for such material.
- F. Quantities Based on Profile Elevations: Existing ground profiles shown on Drawings were taken from a topographic map drawn with contour intervals of 1 foot with supplementary spot elevations to the nearest half foot.
- G. Quantities will be based on ground profiles shown. Field surveys will not be made to confirm accuracy of elevations shown.
- H. Where measurement of quantities depends on elevation of existing ground, elevations obtained during construction will be compared with those shown on Drawings. Variations of 1 foot or less will be ignored, and profiles shown on Drawings will be used for determining quantities.

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- I. Units of measure shown on Bid Form shall be as follows, unless specified otherwise.

Item	Method of Measurement
AC	Acre—Field Measure by Engineer
CY	Cubic Yard—Field Measure by Engineer within limits specified or shown
CY-VM	Cubic Yard—Measured in Vehicle by Volume
EA	Each—Field Count by Engineer
GAL	Gallon—Field Measure by Engineer
HR	Hour
LB	Pound(s)—Weight Measure by Scale
LF	Linear Foot—Field Measure by Engineer
LS	Lump Sum—Unit is one; no measurement will be made.
SF	Square Foot
SY	Square Yard
TON	Ton—Weight Measure by Scale (2,000 pounds)

1.06 PAYMENT

- A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.
- B. Payment for Lump Sum Work covers all Work specified or shown within the limits or Specification sections and as shown on the Drawings.
- C. Payment for unit price items covers all the labor, materials, and services necessary to furnish and install or complete the unit price pay item.

- D. The Description of lump sum and unit price items in the following tables are presented to indicate major categories of Work for purposes of comparative bid analyses and payment breakdown for monthly progress payments. Bid items are not intended to be exclusive descriptions of work categories and Contractor shall determine and include in its pricing all materials, labor, and equipment necessary to complete all of the work as shown and specified in these Contract Documents.

Schedule A	
Item	Description
A1. General Conditions including Bidder's Insurance and Mobilization, Demobilization & Administration	Includes all Bidder's insurance required by the Contract Documents. Includes the obtaining of all bonds, moving all equipment onto the Site; furnishing and erecting temporary construction facilities; demobilization of facilities and equipment; and administration as required for the proper performance and completion of the Work. Payment schedule will be based on the % of work completed.
A2. Centrifugal Pumps and Motors	Includes furnishing and installation of pumps and motors.
A3. Adjustable Frequency Drives	Includes furnishing and installation of AFD.
A4. All other Electrical Equipment	Includes furnishing and installation of electrical appurtenances not included in previous items.
A5. All Minor Piping, Valves and other Mechanical Items	Includes furnishing and installation of minor valves and related piping, and appurtenances inside the existing valve vault. Also includes misc metals such as ladders, vent piping, etc.
A6. Other Misc Items	Items shown on Drawings or Specifications that has not been covered in items A1 through A5.

1.07 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

- A. Payment will not be made for following:
1. Loading, hauling, and disposing of rejected material.
 2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.

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3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

1.08 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

- A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to Engineer. Partial payments will only be made for materials stored on site that have been inspected and accepted by the Engineer.
- B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 13
PROJECT COORDINATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational:

1. Statement of Qualification (SOQ) for land surveyor or Civil Engineer.
2. Photographs:
 - a. Digital Images: Submit on a compact disc within 5 days of being taken.
3. Video Recordings: Submit one copy within 5 days of being taken.

1.02 RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, listed henceforth, is anticipated to be performed at Site by others.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions, Supplemental Conditions, individual specification sections, and Drawings.
3. Include sequencing constraints specified herein as a part of Progress Schedule.

1.03 UTILITY NOTIFICATION AND COORDINATION

A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during Work.

1. Electric Company: Rocky Mountain Power.
 - a. Contact Person: Ken Staples.
 - b. Telephone Number: (503) 813-7152.
2. Water District: Jordan Valley Water Conservancy District.
 - a. Contact Person: Troy Tucker.
 - b. Telephone Number: (801) 565-4349.
3. Public Works Department: City of South Jordan.
 - a. Contact Person: Ken Short.
 - b. Telephone Number: (801) 254-3742.

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1.04 PROJECT MILESTONES AND PROJECT COMPLETION DATES

- A. General: Include the Milestones specified herein as a part of the Progress Schedule required under Section 01 32 00, Construction Progress Documentation.
- B. Project Milestones and Completion:
 - 1. Generally described in the Agreement Form. Following is a detailed description of each with detailed dates listed in the Bid Documents Section:
 - a. Substantial completion of the Project including all hydrostatic testing, disinfection, valve testing and connections to the existing system shall be completed so that the pipeline and reservoirs can be operational and will be put into service. All Work will be complete, except for minor facility work that is not critical to the operation of the Owners water delivery system.
 - b. Final completion shall be 45 days after substantial completion in accordance with Article 14.09 of the General Conditions.

1.05 WORK SEQUENCING/CONSTRAINTS

- A. Work shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the public and to other construction activities around the Site. The Contractor shall be responsible for the coordination and planning of its construction activities and to integrate the construction and schedule constraints into the performance of the Work.
- B. Shutdown of existing systems will need to be coordinated at least 6 weeks in advance with JVWCD. Shutdowns impacting water delivery must be performed during low demand periods generally after September 2026.
- C. All Project facilities will be substantially complete by May 1, 2027.

1.06 FACILITY OPERATIONS

- A. Continuous operation of Owner's facilities and pipelines is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.
- B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's or Utility Companies' operations.

- C. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner's or Utility Companies' facility.
- D. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Engineer or Utility Company. Such authorization will be considered within 48 hours after receipt of Contractor's request.
- E. Relocation of Existing Facilities:
 - 1. During construction, it is expected that minor relocations of Work will be necessary.
 - 2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
 - 3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
 - 4. Perform relocations to minimize downtime of existing facilities.
 - 5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.

1.07 ADJACENT FACILITIES AND PROPERTIES

- A. Examination:
 - 1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
 - 2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.
- B. Documentation:
 - 1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs.
 - 2. Upon receipt, Engineer will review, sign, and return one record copy of documentation to Contractor to be kept on file in field office.

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3. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and is for the protection of adjacent property owners, Contractor, and Owner.

1.08 CONSTRUCTION PHOTOGRAPHS

A. General:

1. Photographically document all phases of the Project including preconstruction, construction progress, and post-construction.
2. Engineer shall have right to select subject matter and vantage point from which photographs are to be taken.
3. Digital Images: No post-session electronic editing of images is allowed. Stored image shall be actual image as captured without cropping or other edits.

B. Preconstruction and Post-Construction:

1. After Effective Date of the Agreement and before Work at Site is started, and again upon issuance of Substantial Completion, take a minimum of 50 photographs of Site and property adjacent to perimeter of Site.
2. Particular emphasis shall be directed to structures adjacent to the pipeline alignment and curb, gutter, storm drainage facilities, driveway approaches, and other items that are intended to be protected during construction.
3. Format: Digital, minimum resolution of 3,264 pixels by 2,448 pixels and 24-bit, millions of color.

C. Construction Progress Photos: Photographically demonstrate progress of construction, showing every aspect of Site and adjacent properties as well as interior and exterior of new or impacted structures.

D. Documentation:

1. Digital Images:
 - a. Electronic image shall have date taken embedded into image.
 - b. Image metadata shall include GPS location of photograph.
 - c. Archive using a commercially available photo management system that provides listing of photographs including date, keyword description, and direction of photograph.
 - d. Label each disk, file folders or database records with Project and Owner's name, and month and year images were produced.

1.09 AUDIO-VIDEO RECORDINGS

- A. Prior to beginning Work on Site or of a particular area of the Work, and again within 10 days following date of Substantial Completion, videograph Site and property adjacent to Site.
- B. In the case of preconstruction recording, no Work shall begin in the area prior to Engineer's review and approval of content and quality of video for that area.
- C. Particular emphasis shall be directed to physical condition of existing vegetation, structures, and pavements within pipeline alignment and areas adjacent to and within the right-of-way or easement, and on Contractor storage and staging areas.
- D. Engineer shall have right to select subject matter and vantage point from which videos are to be taken.
- E. Video Format and Quality:
 - 1. Digital format, with sound.
 - 2. Video:
 - a. Produce bright, sharp, and clear images with accurate colors, free of distortion and other forms of picture imperfections.
 - b. High definition recording with a minimum resolution of 1,920 pixels by 1,080 pixels at 60 frames per second.
 - c. Electronically, and accurately display the month, day, year, and time of day of the recording.
 - 3. Audio:
 - a. Audio documentation shall be done clearly, precisely, and at a moderate pace.
 - b. Indicate date, project name, and a brief description of the location of taping, including:
 - 1) Facility name.
 - 2) Street names or easements.
 - 3) Addresses of private property.
 - 4) Direction of coverage, including engineering stationing, if applicable.

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F. Documentation:

1. Audio-video Recording:
 - a. Archive using a commercially available video management system that provides listing of each segment of video and the following information:
 - 1) Clip number (numbered sequentially, beginning with 001).
 - 2) Project name.
 - 3) Name of street(s) or easement(s) included.
 - 4) Applicable location by engineering stationing.
 - 5) Date and time of coverage.
2. Project Video Log: Maintain an ongoing log that incorporates above noted information for video clips of Project.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SALVAGE OF MATERIALS

- A. Salvage materials for Owner's use.
 1. Remove material with extreme care so as not to damage for future use.
 2. Ensure contaminated material is removed in a manner compliant with relevant standards.
 3. Promptly remove salvaged materials from Work area.
 4. Store materials where instructed by Owner onsite.
- B. Meet with Engineer prior to starting to dismantle equipment or piping designated to be salvaged. Engineer will indicate locations where equipment is to be disconnected.
- C. Provide new or repair damaged equipment or material specified or indicated to be salvaged. Clean and protect equipment from dust, dirt, natural elements, and store as directed.

3.02 CUTTING, FITTING, AND PATCHING

- A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.
- B. Obtain prior written authorization of Engineer before commencing Work to cut or otherwise alter:
 - 1. Structural or reinforcing steel, structural column or beam, elevated slab, trusses, or other structural member.
 - 2. Weather- or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Work of others.
- C. Refinish surfaces to provide an even finish.
 - 1. Refinish continuous surfaces to nearest intersection.
 - 2. Refinish entire assemblies.
 - 3. Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and Work is evident in finished surfaces.
- D. Restore existing work, Underground Facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown on the Drawings.
- E. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.
- F. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.
- G. Remove specimens of installed Work for testing when requested by Engineer.

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit at least 7 days prior to preconstruction conference.
2. Preliminary Submittal Schedule: Submit at least 7 days prior to preconstruction conference.
3. Detailed Progress Schedule:
 - a. Submit initial Detailed Progress Schedule within 30 days after Effective Date of the Agreement.
 - b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
4. Submit with Each Progress Schedule Submission:
 - a. Contractor's certification that Progress Schedule submission is actual schedule being utilized for execution of the Work.
 - b. Electronic file compatible with latest version of Project Planner (P6) by Primavera Systems, Inc., unless otherwise approved by Engineer.
 - c. Progress Schedule: Four legible copies.
 - d. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
 - e. Progress Quantity Chart(s): Same number of copies as specified for Progress Schedule.
5. Prior to final payment, submit a final Updated Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

- A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.
- B. Show activities including, but not limited to the following:
 1. Notice to Proceed.
 2. Permits.
 3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01 33 00, Submittal Procedures.
 4. Early procurement activities for long lead equipment and materials.

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5. Initial Site work.
 6. Earthwork.
 7. Specified Work sequences and construction constraints.
 8. Contract Milestone and Completion Dates.
 9. Owner-furnished products delivery dates or ranges of dates.
 10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.
 11. System startup summary.
 12. Project close-out summary.
 13. Demobilization summary.
- C. Update Preliminary Progress Schedule monthly as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.
- D. Format: In accordance with Article Progress Schedule—Bar Chart.

1.03 PRELIMINARY SUBMITTAL SCHEDULE

- A. List all expected submittals.
- B. Highlight or note submittals that will be substitute or “or-equal” items.
- C. Highlight submittals that could potentially have time constraints requiring a shorter turnaround time than listed in Section 01 33 00, Submittal Procedures, that could potentially impact schedule. These submittals will be given priority in the review process.
- D. Provide updates to the schedule at monthly intervals or as agreed to by the Engineer.

1.04 DETAILED PROGRESS SCHEDULE

- A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.
- B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.
- C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.

- D. Format: In accordance with Article Progress Schedule—Bar Chart.
- E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.05 PROGRESS SCHEDULE—BAR CHART

- A. General: Comprehensive bar chart schedule, generally as outlined in Associated General Contractors of America (AGC) 580, “Construction Project Planning and Scheduling Guidelines.” If a conflict occurs between the AGC publication and this specification, this specification shall govern.
- B. Format:
 - 1. Unless otherwise approved, white paper, 11-inch by 17-inch sheet size.
 - 2. Title Block: Show name of project and Owner, date submitted, revision or update number, and name of scheduler.
 - 3. Identify horizontally, across the top of the schedule, the time frame by year, month, and day.
 - 4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
 - 5. Legend: Describe standard and special symbols used.
- C. Contents:
 - 1. Identify, in chronological order, those activities reasonably required to complete the Work, including as applicable, but not limited to the following:
 - a. Obtaining permits, submittals for early product procurement, and long lead time items.
 - b. Mobilization and other preliminary activities.
 - c. Initial Site work.
 - d. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s).
 - e. Subcontract Work.
 - f. Major equipment design, fabrication, factory testing, and delivery dates.
 - g. Delivery dates for Owner-furnished products, as specified in Section 01 11 00, Summary of Work.
 - h. Sitework.
 - i. Concrete Work.
 - j. Structural steel Work.
 - k. Architectural features Work.
 - l. Conveying systems Work.
 - m. Equipment Work.

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- n. Mechanical Work.
- o. Electrical Work.
- p. Instrumentation and control Work.
- q. Interfaces with Owner-furnished equipment.
- r. Other important Work for each major facility.
- s. Equipment and system startup and test activities.
- t. Project closeout and cleanup.
- u. Demobilization.

1.06 PROGRESS OF THE WORK

- A. Updated Progress Schedule shall reflect:
 - 1. Progress of Work to within 5 working days prior to submission.
 - 2. Approved changes in Work scope and activities modified since submission.
 - 3. Delays in Submittals or resubmittals, deliveries, or Work.
 - 4. Adjusted or modified sequences of Work.
 - 5. Other identifiable changes.
 - 6. Revised projections of progress and completion.
 - 7. Report of changed logic.
- B. Produce detailed subschedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.
- C. If Contractor fails to complete activity by its latest scheduled completion date and this Failure is anticipated to extend Contract Times (or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.
- D. Owner may order Contractor to increase plant, equipment, labor force or working hours if Contractor fails to:
 - 1. Complete a Milestone activity by its completion date.
 - 2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.07 NARRATIVE PROGRESS REPORT

A. Format:

1. Organize same as Progress Schedule.
2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.

B. Contents:

1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.
3. Contractor's plan for management of Site (e.g., lay down and staging areas, construction traffic), utilization of construction equipment, buildup of trade labor, and identification of potential Contract changes.
4. Identification of new activities and sequences as a result of executed Contract changes.
5. Documentation of weather conditions over the reporting period, and any resulting impacts to the work.
6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor-caused delays.

1.08 SCHEDULE ACCEPTANCE

A. Construction Manager's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
 - a. Contract Times, including Final Completion and all intermediate Milestones are within the specified times.
 - b. Specified Work sequences and constraints are shown as specified.
 - c. Specified Owner-furnished Equipment or Material arrival dates, or range of dates, are included.
 - d. Access restrictions are accurately reflected.
 - e. Startup and testing times are as specified.
 - f. Submittal review times are as specified.
 - g. Startup testing duration is as specified and timing is acceptable.

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2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgement, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, during which time Contractor shall update schedule on a monthly basis to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.

- D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to Engineer's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

1.09 ADJUSTMENT OF CONTRACT TIMES

- A. Reference General Conditions and Section 01 26 00, Contract Modification Procedures.
- B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.

C. Schedule Contingency:

1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.
2. Contingency included in Progress Schedule is a Project resource available to both Contractor and Owner to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
4. Pursuant to Contingency sharing provisions of this Specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.

D. Claims Based on Contract Times:

1. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, Contractor shall reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.
2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
3. Contractor shall revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

- A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.
- B. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 SUBMITTAL LIST AND SCHEDULE

- A. Provide preliminary submittal list and schedule as specified in Section 01 32 00, Construction Progress Documentation.
- B. Provide updates to the list and schedule as directed by the Engineer.

1.03 PROCEDURES

- A. Electronic Submittals will be managed through an online Sharepoint site that will be developed at the beginning of the project. Submittals shall, unless specifically accepted, be made in electronic format.
 - 1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
 - 2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
 - 3. PDF files shall be set to open "Bookmarks and Page" view.
 - 4. Add general information to each PDF file, including title, subject, author, and keywords.
 - 5. PDF files shall be set up to print legibly at 8-1/2-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
 - 6. Submit new electronic files for each resubmittal.
 - 7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.

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8. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.
9. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.

B. Transmittal of Submittal:

1. Contractor shall:
 - a. Review each submittal and check for compliance with Contract Documents.
 - b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
 - 1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with Contract Documents.
 - 2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
3. Identify each submittal with the following:
 - a. Numbering and Tracking System:
 - 1) Sequentially number each submittal.
 - 2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
 - b. Specification section and paragraph to which submittal applies.
 - c. Project title and Engineer's project number (WEXE9600).
 - d. Date of transmittal.
 - e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
4. Identify and describe each deviation or variation from Contract Documents.

C. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual Specification section. Do not combine different Specification sections together in submittal package, unless otherwise directed in Specification.

3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
 4. Index with labeled tab dividers in orderly manner.
- D. Timeliness: Schedule and submit in accordance Schedule of Submittals, and requirements of individual specification sections.
- E. Processing Time:
1. Time for review shall commence on Engineer's receipt of submittal.
 2. Engineer will act upon Contractor's submittal and transmit response to Contractor no later than 30 days after receipt, unless otherwise specified.
 3. Resubmittals will be subject to same review time.
 4. No adjustment of Contract Times or Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmittals.
- F. Resubmittals: Clearly identify each correction or change made.
- G. Incomplete Submittals:
1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
 2. When any of the following are missing, submittal will be deemed incomplete:
 - a. Contractor's review stamp, completed and signed.
 - b. Transmittal of Contractor's Submittal, completed and signed.
 - c. Insufficient number of copies.
- H. Submittals not required by Contract Documents:
1. Will not be reviewed and will be returned stamped "Not Subject to Review."
 2. Engineer will keep one copy and return all remaining copies to Contractor.

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1.04 ACTION SUBMITTALS

- A. Prepare and submit Action Submittals required by individual Specification sections.
- B. Shop Drawings:
 - 1. Copies: One electronic copy or provide four hard copies when submittal material is not provided electronically. All submittals shall be electronic unless agreed to otherwise by the Owner and Engineer.
 - 2. Identify and Indicate:
 - a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
 - b. Equipment and Component Title: Identical to title shown on the Drawings.
 - c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
 - d. Project-specific information drawn accurately to scale.
 - 3. Manufacturer's standard schematic drawings and diagrams as follows:
 - a. Modify to delete information that is not applicable to the Work.
 - b. Supplement standard information to provide information specifically applicable to the Work.
 - 4. Product Data: Provide as specified in individual Specifications.
 - 5. Foreign Manufacturers: When proposed, include following additional information.
 - a. Names and addresses of at least two companies that maintain technical service representatives close to Project.
 - b. Complete list of spare parts and accessories for each piece of equipment.
- C. Samples:
 - 1. Copies: Two, unless otherwise specified in individual Specifications.
 - 2. Preparation:
 - a. Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
 - 1) Manufacturer name.
 - 2) Model number.
 - 3) Material.
 - 4) Sample source.

3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
 4. Full-size Samples:
 - a. Size as indicated in individual Specification section.
 - b. Prepared from same materials to be used for the Work.
 - c. Cured and finished in manner specified.
 - d. Physically identical with product proposed for use.
- D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted.
1. Approved:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal.
 - b. Distribution. Primary distribution will be electronic. For hard copy submittals:
 - 1) One copy furnished Owner.
 - 2) One copy retained in Engineer's file.
 - 3) Remaining copies returned to Contractor appropriately annotated.
 2. Approved as Noted:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - b. Distribution. Primary distribution will be electronic. For hard copy submittals:
 - 1) One copy furnished Owner.
 - 2) One copy retained in Engineer's file.
 - 3) Remaining copies returned to Contractor appropriately annotated.
 3. Partial Approval, Resubmit as Noted:
 - a. Make corrections or obtain missing portions, and resubmit.
 - b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - c. Distribution. Primary distribution will be electronic. For hard copy submittals:
 - 1) One copy furnished Owner.
 - 2) One copy retained in Engineer's file.
 - 3) Remaining copies returned to Contractor appropriately annotated.

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4. Revise and Resubmit:
 - a. Contractor may not incorporate product(s) or implement Work covered by submittal.
 - b. Distribution. Primary distribution will be electronic. For hard copy submittals:
 - 1) One copy retained in Engineer's file.
 - 2) Remaining copies returned to Contractor appropriately annotated.

1.05 INFORMATIONAL SUBMITTALS

A. General:

1. Copies: One electronic copy or submit three hard copies when submittal material is not provided electronically, unless otherwise indicated in individual Specification section.
2. Refer to individual Specification sections for specific submittal requirements.
3. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copies to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copies with review comments to Contractor, and require that submittal be corrected and resubmitted.

B. Certificates:

1. General:
 - a. Provide notarized statement that includes signature of entity responsible for preparing certification.
 - b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual Specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying that installer complies with requirements as specified in individual Specification sections.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual Specification sections.

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6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
 7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01 43 33, Manufacturers' Field Services.
- C. Construction Photographs and Video: In accordance with Section 01 31 13, Project Coordination, and as may otherwise be required in Contract Documents.
- D. Contract Closeout Submittals: In accordance with Section 01 77 00, Closeout Procedures.
- E. Contractor-Design Data:
1. Written and graphic information.
 2. List of assumptions.
 3. List of performance and design criteria.
 4. Summary of loads or load diagram, if applicable.
 5. Calculations.
 6. List of applicable codes and regulations.
 7. Name and version of software.
 8. Information requested in individual Specification section.
- F. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual Specification section.
- G. Operation and Maintenance Data: As required in Section 01 78 23, Operation and Maintenance Data.
- H. Payment:
1. Application for Payment: In accordance with Section 01 29 00, Payment Procedures.
 2. Schedule of Values: In accordance with Section 01 29 00, Payment Procedures.
 3. Schedule of Estimated Progress Payments: In accordance with Section 01 29 00, Payment Procedures.
- I. Quality Control Documentation: As required in Section 01 45 16.13, Contractor Quality Control.

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- J. Schedules:
1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01 32 00, Construction Progress Documentation.
 - a. Show for each, at a minimum, the following:
 - 1) Specification section number.
 - 2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
 - 3) Estimated date of submission to Engineer, including reviewing and processing time.
 - b. On a monthly basis, submit updated schedule to Engineer if changes have occurred or resubmittals are required.
 2. Progress Schedules: In accordance with Section 01 32 00, Construction Progress Documentation.
- K. Special Guarantee: Supplier's written guarantee as required in individual Specification sections.
- L. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.
- M. Submittals Required by Laws, Regulations, and Governing Agencies:
1. Promptly submit notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
 2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.
- N. Test, Evaluation, Inspection Reports:
1. General: Shall contain signature of person responsible for test or report.
 2. Factory:
 - a. Identification of product and Specification section, type of inspection or test with referenced standard or code.
 - b. Date of test, Project title and number, and name and signature of authorized person.
 - c. Test results.
 - d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.

- e. Provide interpretation of test results, when requested by Engineer.
 - f. Other items as identified in individual Specification sections.
3. Field:
- a. As a minimum, include the following:
 - 1) Project title and number.
 - 2) Date and time.
 - 3) Record of temperature and weather conditions.
 - 4) Identification of product and Specification section.
 - 5) Type and location of test, Sample, or inspection, including referenced standard or code.
 - 6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
 - 7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - 8) Provide interpretation of test results, when requested by Engineer.
 - 9) Other items as identified in individual Specification sections.

- O. Testing and Startup Data: In accordance with Section 01 91 14, Equipment Testing and Facility Startup.
- P. Training Data: In accordance with Section 01 43 33, Manufacturers' Field Services.

1.06 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification:
 - 1. Transmittal of Contractor's Submittal Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION



TRANSMITTAL OF CONTRACTOR'S SUBMITTAL
 (ATTACH TO EACH SUBMITTAL)

DATE: _____

TO: _____

Submittal No.: _____

New Submittal Resubmittal

Project: _____

Project No.: _____

Specification Section No.: _____

(Cover only one section with each transmittal)

Schedule Date of Submittal:

FROM: _____
 Contractor

SUBMITTAL TYPE: Shop Drawing Sample Informational
 Deferred

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure No.	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
 Contractor (Authorized Signature)

SECTION 01 42 13
ABBREVIATIONS AND ACRONYMS

PART 1 GENERAL

1.01 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

- A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Article 3 of the General Conditions, and as may otherwise be required herein and in the individual Specification sections.
- B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.
- C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.
- D. Where two or more standards are specified to establish quality, product and workmanship shall meet or exceed requirements of most stringent.
- E. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.
- F. Copies of standards and specifications of technical societies:
 - 1. Copies of applicable referenced standards have not been bound in these Contract Documents.
 - 2. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor's personnel, Subcontractors, Owner, and Engineer.

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1.02 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

1.	AA	Aluminum Association
2.	AABC	Associated Air Balance Council
3.	AAMA	American Architectural Manufacturers Association
4.	AASHTO	American Association of State Highway and Transportation Officials
5.	ABMA	American Bearing Manufacturers' Association
6.	ACI	American Concrete Institute
7.	AEIC	Association of Edison Illuminating Companies
8.	AGA	American Gas Association
9.	AGMA	American Gear Manufacturers' Association
10.	AI	Asphalt Institute
11.	AISC	American Institute of Steel Construction
12.	AISI	American Iron and Steel Institute
13.	AITC	American Institute of Timber Construction
14.	ALS	American Lumber Standards
15.	AMCA	Air Movement and Control Association
16.	ANSI	American National Standards Institute
17.	APA	APA – The Engineered Wood Association
18.	API	American Petroleum Institute
19.	APWA	American Public Works Association
20.	AHRI	Air-Conditioning, Heating, and Refrigeration Institute
21.	ASA	Acoustical Society of America
22.	ASABE	American Society of Agricultural and Biological Engineers
23.	ASCE	American Society of Civil Engineers
24.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
25.	ASME	American Society of Mechanical Engineers
26.	ASNT	American Society for Nondestructive Testing
27.	ASSE	American Society of Sanitary Engineering
28.	ASTM	ASTM International
29.	AWI	Architectural Woodwork Institute
30.	AWPA	American Wood Preservers' Association
31.	AWPI	American Wood Preservers' Institute
32.	AWS	American Welding Society
33.	AWWA	American Water Works Association
34.	BHMA	Builders Hardware Manufacturers' Association
35.	CBM	Certified Ballast Manufacturer

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36.	CDA	Copper Development Association
37.	CGA	Compressed Gas Association
38.	CISPI	Cast Iron Soil Pipe Institute
39.	CMAA	Crane Manufacturers' Association of America
40.	CRSI	Concrete Reinforcing Steel Institute
41.	CS	Commercial Standard
42.	CSA	Canadian Standards Association
43.	CSI	Construction Specifications Institute
44.	DIN	Deutsches Institut für Normung e.V.
45.	DIPRA	Ductile Iron Pipe Research Association
46.	EIA	Electronic Industries Alliance
47.	EJCDC	Engineers Joint Contract Documents' Committee
48.	ETL	Electrical Test Laboratories
49.	FAA	Federal Aviation Administration
50.	FCC	Federal Communications Commission
51.	FDA	Food and Drug Administration
52.	FEMA	Federal Emergency Management Agency
53.	FIPS	Federal Information Processing Standards
54.	FM	FM Global
55.	Fed. Spec.	Federal Specifications (FAA Specifications)
56.	FS	Federal Specifications and Standards (Technical Specifications)
57.	GA	Gypsum Association
58.	GANA	Glass Association of North America
59.	HI	Hydraulic Institute
60.	HMI	Hoist Manufacturers' Institute
61.	IBC	International Building Code
62.	ICBO	International Conference of Building Officials
63.	ICC	International Code Council
64.	ICEA	Insulated Cable Engineers' Association
65.	IFC	International Fire Code
66.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
67.	IESNA	Illuminating Engineering Society of North America
68.	IFI	Industrial Fasteners Institute
69.	IGMA	Insulating Glass Manufacturer's Alliance
70.	IMC	International Mechanical Code
71.	INDA	Association of the Nonwoven Fabrics Industry
72.	IPC	International Plumbing Code
73.	ISA	International Society of Automation
74.	ISO	International Organization for Standardization
75.	ITL	Independent Testing Laboratory
76.	JIC	Joint Industry Conferences of Hydraulic Manufacturers
77.	MIA	Marble Institute of America

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78.	MIL	Military Specifications
79.	MMA	Monorail Manufacturers' Association
80.	MSS	Manufacturer's Standardization Society
81.	NAAMM	National Association of Architectural Metal Manufacturers
82.	NACE	NACE International
83.	NBGQA	National Building Granite Quarries Association
84.	NEBB	National Environmental Balancing Bureau
85.	NEC	National Electrical Code
86.	NECA	National Electrical Contractor's Association
87.	NEMA	National Electrical Manufacturers' Association
88.	NESC	National Electrical Safety Code
89.	NETA	InterNational Electrical Testing Association
90.	NFPA	National Fire Protection Association
91.	NHLA	National Hardwood Lumber Association
92.	NICET	National Institute for Certification in Engineering Technologies
93.	NIST	National Institute of Standards and Technology
94.	NRCA	National Roofing Contractors Association
95.	NRTL	Nationally Recognized Testing Laboratories
96.	NSF	NSF International
97.	NSPE	National Society of Professional Engineers
98.	NTMA	National Terrazzo and Mosaic Association
99.	NWWDA	National Wood Window and Door Association
100.	OSHA	Occupational Safety and Health Act (both Federal and State)
101.	PCI	Precast/Prestressed Concrete Institute
102.	PEI	Porcelain Enamel Institute
103.	PPI	Plastic Pipe Institute
104.	PS	Product Standards Section-U.S. Department of Commerce
105.	RMA	Rubber Manufacturers' Association
106.	RUS	Rural Utilities Service
107.	SAE	SAE International
108.	SDI	Steel Deck Institute
109.	SDI	Steel Door Institute
110.	SJI	Steel Joist Institute
111.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
112.	SPI	Society of the Plastics Industry
113.	SSPC	The Society for Protective Coatings
114.	STI/SPFA	Steel Tank Institute/Steel Plate Fabricators Association
115.	SWI	Steel Window Institute

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116.	TEMA	Tubular Exchanger Manufacturers' Association
117.	TCA	Tile Council of North America
118.	TIA	Telecommunications Industry Association
119.	UBC	Uniform Building Code
120.	UFC	Uniform Fire Code
121.	UL	formerly Underwriters Laboratories Inc.
122.	UMC	Uniform Mechanical Code
123.	USBR	U.S. Bureau of Reclamation
124.	WCLIB	West Coast Lumber Inspection Bureau
125.	WI	Wood Institute
126.	WWPA	Western Wood Products Association

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 33
MANUFACTURERS' FIELD SERVICES

PART 1 GENERAL

1.01 DEFINITIONS

- A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02 SUBMITTALS

- A. Informational Submittals:

1. Training Schedule: Submit, in accordance with requirements of this specification, not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.
2. Lesson Plan: Submit, in accordance with requirements of this specification, proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

- A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified in the individual specification section.
- B. Representative subject to acceptance by Owner and Engineer. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

- A. Furnish manufacturers' services when required by an individual specification section, to meet the requirements of this section.
- B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental.

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- C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.
- D. Determine, before scheduling services, that all conditions necessary to allow successful testing have been met.
- E. Only those days of service approved by Engineer will be credited to fulfill the specified minimum services.
- F. When specified in individual specification sections, manufacturer's onsite services shall include:
 - 1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
 - 2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
 - 3. Providing, on a daily basis, copies of all manufacturer's representatives' field notes and data to Engineer.
 - 4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.
 - 5. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
 - 6. Assistance during functional and performance testing, and facility startup and evaluation.
 - 7. Training of Owner's personnel in the operation and maintenance of respective product as required.
 - 8. Additional requirements may be listed in the individual specification sections.

3.02 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

- A. When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by the equipment manufacturer's representative.
- B. Such form shall certify signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

3.03 TRAINING

A. General:

1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01 78 23, Operation and Maintenance Data.
3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

B. Training Schedule:

1. List specified equipment and systems that require training services and show:
 - a. Respective manufacturer.
 - b. Estimated dates for installation completion.
 - c. Estimated training dates.
2. Allow for multiple sessions when several shifts are involved.
3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
4. Coordinate with Section 01 32 00, Construction Progress Documentation, and Section 01 91 14, Equipment Testing and Facility Startup.

C. Lesson Plan: When manufacturer or vendor training of Owner personnel is specified, prepare a lesson plan for each required course containing the following minimum information.

1. Title and objectives.
2. Recommended attendees (e.g., managers, engineers, operators, maintenance).
3. Course description, outline of course content, and estimated class duration.

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4. Format (e.g., lecture, self-study, demonstration, hands-on).
5. Instruction materials and equipment requirements.
6. Resumes of instructors providing the training.

D. Pre-startup Training:

1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01 78 23, Operation and Maintenance Data.
2. Complete at least 14 days prior to beginning of facility startup.

E. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

3.04 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification.
1. Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO: _____

EQPT TAG NO: _____ EQPT/SYSTEM: _____

PROJECT NO: _____ SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- Installed in accordance with Manufacturer's recommendations.
- Inspected, checked, and adjusted.
- Serviced with proper initial lubricants.
- Electrical and mechanical connections meet quality and safety standards.
- All applicable safety equipment has been properly installed.
- Functional tests.
- System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments: _____

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

Date: _____, 20__

Manufacturer: _____

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

SECTION 01 45 16.13
CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM): E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

- A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.03 SUBMITTALS

- A. Informational Submittals:
1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
 2. CQC Report: Submit, weekly, an original and one copy in report form.

1.04 OWNER'S QUALITY ASSURANCE

- A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.
- B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:
1. Relieve Contractor of responsibility for providing adequate quality control measures.
 2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance.
 3. Constitute or imply acceptance.
 4. Affect the continuing rights of Owner after acceptance of the completed Work.
- C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.

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- D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.
- E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.
- B. Maintain complete inspection records and make them available at all times to Owner and Engineer.
- C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

- A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.
- B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor's management and control with the Owner's Quality Assurance.
- C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

3.03 QUALITY CONTROL ORGANIZATION

A. CQC System Manager:

1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
2. CQC System Manager may perform other duties on the Project.
3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years' construction experience on similar type Work.
4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.

B. CQC Staff:

1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Engineer.
2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.

C. Organizational Changes: Obtain Engineer's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

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3.04 QUALITY CONTROL PHASING

- A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:
1. Preparatory Phase:
 - a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
 - b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
 - c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.
 - d. Perform prior to beginning Work on each definable feature of Work:
 - 1) Review applicable Contract Specifications.
 - 2) Review applicable Contract Drawings.
 - 3) Verify that all materials and/or equipment have been tested, submitted, and approved.
 - 4) Verify that provisions have been made to provide required control inspection and testing.
 - 5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
 - 6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
 - 7) Review the appropriate activity hazard analysis to verify safety requirements are met.
 - 8) Review procedures for constructing the Work, including repetitive deficiencies.
 - 9) Document construction tolerances and workmanship standards for that phase of the Work.
 - 10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.

2. Initial Phase:
 - a. Accomplish at the beginning of a definable feature of Work:
 - 1) Notify Owner at least 48 hours in advance of beginning the initial phase.
 - 2) Perform prior to beginning Work on each definable feature of Work:
 - a) Review minutes of the preparatory meeting.
 - b) Check preliminary Work to verify compliance with Contract requirements.
 - c) Verify required control inspection and testing.
 - d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
 - e) Resolve all differences.
 - f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
 - 3) Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
 - 4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
3. Follow-up Phase:
 - a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
 - b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
 - c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

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3.05 CONTRACTOR QUALITY CONTROL PLAN

A. General:

1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
2. An interim plan for the first 30 days of operation will be considered.
3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.

B. Content:

1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
 - a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Article Quality Control Phasing) for all aspects of the Work specified.
 - b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
 - c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
 - d. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
 - e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.

- f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
 - g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
 - h. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.
- C. Acceptance of Plans: Acceptance of the Contractor's basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.
- D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Engineer, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Engineer.

3.06 CONTRACTOR QUALITY CONTROL REPORT

- A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.
- B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.
- C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:
 - 1. Contractor/subcontractor and their areas of responsibility.
 - 2. Operating plant/equipment with hours worked, idle, or down for repair.
 - 3. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
 - 4. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
 - 5. Material received with statement as to its acceptability and storage.

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6. Identify submittals reviewed, with Contract reference, by whom, and action taken.
7. Offsite surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. List instructions given/received and conflicts on Drawings and/or Specifications.
10. Contractor's verification statement.
11. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
12. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

3.07 SUBMITTAL QUALITY CONTROL

- A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.08 TESTING QUALITY CONTROL

- A. Testing Procedure:
 1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Procure services of a licensed testing laboratory. Perform the following activities and record the following data:
 - a. Verify testing procedures comply with contract requirements.
 - b. Verify facilities and testing equipment are available and comply with testing standards.
 - c. Check test instrument calibration data against certified standards.
 - d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
 - e. Documentation:
 - 1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
 - 2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.

- 3) Actual test reports may be submitted later, if approved by Engineer, with a reference to the test number and date taken.
- 4) Provide directly to Engineer an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
- 5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.

- B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.09 COMPLETION INSPECTION

- A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.
- B. Punchlist:
1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
 2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
 3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
 4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

**SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

- A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of latest edition of International Building Code (IBC) by International Code Council and design parameters shown on the General Structural Notes on the Drawings.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 4,500 feet above sea level.
- B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of minus 10 degrees F to 110 degrees F.

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1.04 PREPARATION FOR SHIPMENT

- A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.
- B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.
- C. Extra Materials, Special Tools, Test Equipment, and Expendables:
 - 1. Furnish as required by individual Specifications.
 - 2. Schedule:
 - a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
 - b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
 - 3. Packaging and Shipment:
 - a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
 - b. Prominently displayed on each package, the following:
 - 1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
 - 2) Applicable equipment description.
 - 3) Quantity of parts in package.
 - 4) Equipment manufacturer.
 - 4. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.
- D. Request a minimum 7-day advance notice of shipment from manufacturer. Upon receipt of manufacturer's advance notice of shipment, promptly notify Engineer of anticipated date and place of equipment arrival.
- E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.05 DELIVERY AND INSPECTION

- A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.
- B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.
- C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.
- D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.06 HANDLING, STORAGE, AND PROTECTION

- A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.
- B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.
- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.
- D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

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- E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.
- G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.
- H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.
- B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.
- C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.
- D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
- F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and

accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

- G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.
- H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.
- I. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.
- J. Equipment Finish:
 - 1. Provide manufacturer's standard finish and color, except where specific color is indicated.
 - 2. If manufacturer has no standard color, provide equipment with gray finish as approved by Engineer.
- K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.
- L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

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2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

- A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.
- B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
- C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

- A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

- A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by the entity supplying the product, material, or service, and submitted prior to shipment of product or material or the execution of the services.
- B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Such form shall certify that the proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

- A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. No shimming between machined surfaces is allowed.
- C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Repaint painted surfaces that are damaged prior to equipment acceptance.
- E. Do not cut or notch any structural member or building surface without specific approval of Engineer.
- F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.

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- G. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.04 FIELD FINISHING

- A. In accordance with Section 09 90 00, Painting and Coating, and individual Specification sections.

3.05 ADJUSTMENT AND CLEANING

- A. Perform required adjustments, tests, operation checks, and other startup activities.

3.06 LUBRICANTS

- A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.07 SUPPLEMENT

- A. The supplement listed below, following “End of Section,” is part of this specification:
 - 1. Manufacturer’s Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER: _____ PRODUCT, MATERIAL, OR SERVICE
SUBMITTED: _____
PROJECT NAME: _____
PROJECT NO: _____

Comments: _____

I hereby certify that the above-referenced product, material, or service called for by the contract for the named project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the contract requirements, and are in the quantity shown.

Date of Execution: _____, 20__

Manufacturer: _____

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

(Authorized Signature)

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Detailed information for the preparation, submission, and Engineer's review of Operations and Maintenance (O&M) Data, as required by individual specification sections.

1.02 DEFINITIONS

- A. Final Data: Engineer-accepted data, submitted as specified herein.
- B. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.
- C. Preliminary Data: Initial and subsequent submissions for Engineer's review.

1.03 SEQUENCING AND SCHEDULING

- A. Equipment and System Data:
 - 1. Preliminary Data:
 - a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
 - b. Submit prior to shipment date.
 - 2. Final Data: Submit Compilation Formatted and Electronic Media Formatted data prior to Substantial Completion of Project.
- B. Materials and Finishes Data:
 - 1. Preliminary Data: Submit at least 15 days prior to request for final inspection.
 - 2. Final Data: Submit within 10 days after final inspection.

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1.04 DATA FORMAT

- A. Prepare preliminary and final data in the form of an instructional manual. Prepare preliminary and final data in electronic media format.
- B. Electronic Media Format:
 - 1. Portable Document Format (PDF):
 - a. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format on a portable USB drive.
 - b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
 - c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.

1.05 SUBMITTALS

- A. Informational:
 - 1. Data Outline: Submit three copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
 - 2. Preliminary Data:
 - a. Submit two copies for Engineer's review.
 - b. If data meets conditions of the Contract:
 - 1) One copy will be returned to Contractor.
 - 2) One copy will be retained in Engineer's file.
 - c. If data does not meet conditions of the Contract:
 - 1) All copies will be returned to Contractor with Engineer's comments (on separate document) for revision.
 - 2) Engineer's comments will be retained in Engineer's file.
 - 3) Resubmit two copies revised in accordance with Engineer's comments.
 - 3. Final Data: Submit two copies in formats specified herein.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

- A. Content For Each Unit (or Common Units) and System:
 - 1. Product Data:
 - a. Include only those sheets that are pertinent to specific product.
 - b. Clearly annotate each sheet to:
 - 1) Identify specific product or part installed.
 - 2) Identify data applicable to installation.

- 3) Delete references to inapplicable information.
 - c. Function, normal operating characteristics, and limiting conditions.
 - d. Performance curves, engineering data, nameplate data, and tests.
 - e. Complete nomenclature and commercial number of replaceable parts.
 - f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
 - g. Spare parts ordering instructions.
 - h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
2. As-installed, color-coded piping diagrams.
3. Charts of valve tag numbers, with the location and function of each valve.
4. Drawings:
 - a. Supplement product data with Drawings as necessary to clearly illustrate:
 - 1) Format:
 - a) Provide reinforced, punched, binder tab; bind in with text.
 - b) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
 - c) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
 - d) Identify Specification section and product on the Drawings and envelopes.
 - 2) Relations of component parts of equipment and systems.
 - 3) Control and flow diagrams.
 - 4) Coordinate Drawings with Project record documents to assure correct illustration of completed installation.
5. Instructions and Procedures: Within text, as required to supplement product data.
 - a. Format:
 - 1) Organize in consistent format under separate heading for each different procedure.
 - 2) Provide logical sequence of instructions for each procedure.
 - 3) Provide information sheet for Owner's personnel, including:
 - a) Proper procedures in event of failure.
 - b) Instances that might affect validity of guarantee or Bond.
 - b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.

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- c. Operating Procedures:
 - 1) Startup, break-in, routine, and normal operating instructions.
 - 2) Test procedures and results of factory tests where required.
 - 3) Regulation, control, stopping, and emergency instructions.
 - 4) Description of operation sequence by control manufacturer.
 - 5) Shutdown instructions for both short and extended duration.
 - 6) Summer and winter operating instructions, as applicable.
 - 7) Safety precautions.
 - 8) Special operating instructions.
 - d. Maintenance and Overhaul Procedures:
 - 1) Routine maintenance.
 - 2) Guide to troubleshooting.
 - 3) Disassembly, removal, repair, reinstallation, and re-assembly.
- B. Content for Each Electric or Electronic Item or System:
- 1. Description of Unit and Component Parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, nameplate data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Interconnection wiring diagrams, including control and lighting systems.
 - 2. Circuit Directories of Panelboards:
 - a. Electrical service.
 - b. Control requirements and interfaces.
 - c. Communication requirements and interfaces.
 - d. List of electrical relay settings, and control and alarm contact settings.
 - 3. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
 - 4. As-installed control diagrams by control manufacturer.
 - 5. Operating Procedures:
 - a. Routine and normal operating instructions.
 - b. Startup and shutdown sequences, normal and emergency.
 - c. Safety precautions.
 - d. Special operating instructions.
 - 6. Maintenance Procedures:
 - a. Routine maintenance.
 - b. Guide to troubleshooting.

- c. Adjustment and checking.
 - d. List of relay settings, control and alarm contact settings.
 7. Manufacturer's printed operating and maintenance instructions.
 8. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
- C. Maintenance Summary:
 1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
 2. Format:
 - a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
 - b. Each Maintenance Summary may take as many pages as required.
 - c. Use only 8-1/2-inch by 11-inch size paper.
 - d. Complete using typewriter or electronic printing.
 3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.
 4. Recommended Spare Parts:
 - a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
 - b. "Unit" is the unit of measure for ordering the part.
 - c. "Quantity" is the number of units recommended.
 - d. "Unit Cost" is the current purchase price.

1.07 DATA FOR MATERIALS AND FINISHES

- A. Content for Architectural Products, Applied Materials, and Finishes:
 1. Manufacturer's data, giving full information on products:
 - a. Catalog number, size, and composition.
 - b. Color and texture designations.
 - c. Information required for reordering special-manufactured products.
 2. Instructions for Care and Maintenance:
 - a. Manufacturer's recommendation for types of cleaning agents and methods.
 - b. Cautions against cleaning agents and methods that are detrimental to product.
 - c. Recommended schedule for cleaning and maintenance.

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B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
 - a. Applicable standards.
 - b. Chemical composition.
 - c. Details of installation.
2. Instructions for inspection, maintenance, and repair.

1.08 SUPPLEMENT

A. The supplement listed below, following "End of Section," is a part of this specification:

1. Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT: _____ CONTRACT NO.: _____

1. EQUIPMENT ITEM _____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS) _____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

a. Name _____ Telephone No. _____

b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	Frequency	Lubricant (If Applicable)
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

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8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobil	Chevron Texaco	BP Amoco	“Or-Equal”
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER’S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost

Note: Identify parts provided by this Contract with two asterisks.

SECTION 01 91 14
EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

- A. Facility: Entire Project, or an agreed-upon portion.
- B. Functional Test: Test or tests in presence of Engineer and Owner to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.
- C. Performance Test: Test or tests performed after any required functional test in presence of Engineer and Owner to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.
- D. Unit Process: As used in this section, a unit process is a portion of the facility that performs a specific process function, such as metering flows, isolation valves, air valves, and other system components critical to the operation of the system.
- E. Facility Performance Demonstration:
 - 1. A demonstration, conducted by Contractor, with assistance of Owner, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with Owner and as accepted by Engineer.
 - 2. Such demonstration is for the purposes of (i) verifying to Owner entire facility performs as a whole, and (ii) documenting performance characteristics of completed facility for Owner's records. Neither the demonstration nor the evaluation is intended in any way to make performance of a unit process or entire facility the responsibility of Contractor, unless such performance is otherwise specified.

1.02 SUBMITTALS

- A. Informational Submittals:
 - 1. Facility Startup and Performance Demonstration Plan.
 - 2. Functional and performance test results.
 - 3. Completed Unit Process Startup Form for each unit process.
 - 4. Completed Facility Performance Demonstration/Certification Form.

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1.03 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN

- A. Develop a written plan, in conjunction with Owner's operations personnel; to include the following:
1. Step-by-step instructions for startup of each unit process and the complete facility.
 2. Unit Process Startup Form (sample attached), to minimally include the following:
 - a. Description of the unit process, including equipment numbers/nomenclature of each item of equipment and all included devices.
 - b. Detailed procedure for startup of the unit process, including valves to be opened/closed, order of equipment startup, etc.
 - c. Startup requirements for each unit process, including water, power, chemicals, etc.
 - d. Space for evaluation comments.
 3. Facility Performance Demonstration/Certification Form (sample attached), to minimally include the following:
 - a. Description of unit processes included in the facility startup.
 - b. Sequence of unit process startup to achieve facility startup.
 - c. Description of computerized operations, if any, included in the facility.
 - d. Contractor certification facility is capable of performing its intended function(s), including fully automatic operation.
 - e. Signature spaces for Contractor and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Facility Startup Meetings: Schedule, in accordance with requirements of Section 01 31 19, Project Meetings, to discuss test schedule, test methods, materials, chemicals and liquids required, facilities operations interface, and Owner involvement.
- B. Contractor's Testing and Startup Representative:
1. Designate and furnish one or more personnel to coordinate and expedite testing and facility startup.
 2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.

- C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.
- D. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing work so as not to interfere with or delay testing and startup.

3.02 EQUIPMENT TESTING

A. Preparation:

- 1. Complete installation before testing.
- 2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
- 3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01 43 33, Manufacturers' Field Services, when required by individual Specification sections.
- 4. Equipment Test Report Form: Provide written test report for each item of equipment to be tested, to include the minimum information:
 - a. Owner/Project Name.
 - b. Equipment or item tested.
 - c. Date and time of test.
 - d. Type of test performed (Functional or Performance).
 - e. Test method.
 - f. Test conditions.
 - g. Test results.
 - h. Signature spaces for Contractor and Engineer as witness.
- 5. Cleaning and Checking:
 - a. Prior to beginning functional testing:
 - 1) Calibrate testing equipment in accordance with manufacturer's instructions.
 - 2) Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
 - 3) Lubricate equipment in accordance with manufacturer's instructions.
 - 4) Turn rotating equipment by hand when possible to confirm that equipment is not bound.
 - 5) Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
 - 6) Check power supply to electric-powered equipment for correct voltage.
 - 7) Adjust clearances and torque.
 - 8) Test piping for leaks.

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6. Ready-to-test determination will be by Resident Project Representative based at least on the following:
 - a. Acceptable Operation and Maintenance Data.
 - b. Notification by Contractor of equipment readiness for testing.
 - c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
 - d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
 - e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
 - f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
 - g. Equipment and electrical tagging complete.
 - h. Delivery of all spare parts and special tools.

B. Functional Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
3. Prepare Equipment Test Report summarizing test method and results.
4. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so, required by individual Specification sections. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.

C. Performance Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Engineer and Owner in writing at least 10 days prior to scheduled date of test.
3. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements specified.
4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.
6. Prepare Equipment Test Report summarizing test method and results.
7. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as conforming to Contract requirements. Such acceptance will be evidenced by Engineer's signature on Equipment Test Report.

3.03 FACILITY PERFORMANCE DEMONSTRATION

- A. When, in the opinion of Engineer, startup of all unit processes has been achieved, sequence each unit process to the point that facility is operational.
- B. Demonstrate proper operation of required interfaces within and between individual unit processes and equipment.

3.04 SUPPLEMENTS

- A. Supplements listed below, following “End of Section,” are a part of this specification:
 - 1. Unit Process Startup Form.
 - 2. Facility Performance Demonstration/Certification Form.

END OF SECTION

UNIT PROCESS STARTUP FORM

OWNER: _____ **PROJECT:** _____

Unit Process Description: (Include description and equipment number of all equipment and devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

Startup Requirements (Water, power, chemicals, etc.): _____

Evaluation Comments: _____

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER: _____ **PROJECT:** _____

Unit Processes Description (List unit processes involved in facility startup):

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ **Date:** _____, 20____

Engineer: _____ **Date:** _____, 20____
(Authorized Signature)

SECTION 03 30 10
STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 GENERAL

- A. Unless otherwise specified, Work shall conform to requirements of ACI 301, Specifications for Concrete Construction (ACI 301).

1.02 REFERENCES

- A. In accordance with referenced standards of ACI 301 and the following:
1. American Concrete Institute (ACI):
 - a. 301, Specifications for Concrete Construction.
 - b. 305.1, Specification for Hot Weather Concreting.
 - c. 306.1, Standard Specification for Cold Weather Concreting.
 - d. 308.1, External Curing of Cast-In-Place Concrete —Specification.
 - e. 350.1, Tightness Testing of Environmental Engineering Concrete Structures—Specification.
 - f. MNL-66, ACI Detailing Manual.
 2. ASTM International (ASTM):
 - a. D994/D994M, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).Concrete Reinforcing Steel Institute (CRSI):
 - b. Manual of Standard Practice.
 - c. Placing Reinforcing Bars.
 3. American National Standards Institute (ANSI): ANSI/CRSI – RB 4.1, CRSI Standard for Supports for Reinforcement Used in Concrete. Corps of Engineers (COE): CRD-C-572, Corps of Engineers Specifications for Polyvinylchloride Waterstop.
 4. National Ready Mixed Concrete Association (NRMCA).
 5. NSF International (NSF): NSF/ANSI 61, Drinking Water System Components – Health Effects.

1.03 DEFINITIONS

- A. Unless otherwise specified use Definitions of ACI 301.
- B. When a definition occurs in ACI 301 and this document, the definition given in this document governs.

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- C. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.
- D. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4 inch in diameter, cold joints, unless otherwise noted cracks at the surface of the concrete member that wider than 0.007 inch, cracks in concrete members that are part of a retaining structure that at are wider than 0.004 inch, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.
- E. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained. A concrete surface shall be considered exposed, even when the surface is specified to be covered by stain, paint, or coating.
- F. Hot Weather: As defined in ACI 305.1, Specification for Hot Weather Concreting (ACI 305.1).
- G. Retaining Structure: Structures including those that retain liquid or granular material including soil; habitable below-grade structures; environmental engineering concrete structures; structural elements that extend over retained liquid or material, even when not in direct contact with liquid or material.
- H. New Concrete: Concrete less than 60 days old.
- I. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Formwork and Formwork Accessories: Unless otherwise specified, conform to requirements of ACI 301.
 - b. Reinforcing steel prepared in accordance with CRSI Manual of Standard Practice and ACI MNL-66 Detailing Manual:
 - 1) Bending lists.
 - 2) Placing drawings.

- c. Waterstop: Details of splices, method of securing and supporting waterstop in forms to maintain proper orientation and location during concrete placement.
 - d. Construction Joints, Expansion Joints, and Control Joints: Layout and location for each type.
2. Mix Design:
- a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
 - b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
 - c. Manufacturer's Certificate of Compliance for the following:
 - 1) Portland cement.
 - 2) Fly ash.
 - 3) Slag cement.
 - 4) Aggregates, including specified class designation for coarse aggregate.
 - 5) Admixtures.
 - 6) Concrete producer has verified compatibility of constituent materials in design mix.
 - d. Test Reports:
 - 1) Cement: Chemical analysis report.
 - 2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
 - 3) Aggregates:
 - a) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
 - b) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
 - 4) Alkali Aggregate Reactivity: Where required, in accordance with Paragraph Concrete Mix Design. Include documentation of test results per applicable standards.
 - e. Product Data:
 - 1) Admixtures: Manufacturer's product data sheets for each admixture used in proposed mix designs.
3. Concrete repair techniques.

B. Informational Submittals:

- 1. Preinstallation Conference minutes.
- 2. Manufacturer's application instructions for bonding agent and bond breaker.

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3. Manufacturer's Certificate of Compliance to specified standards:
 - a. Bonding agent.
 - b. Bond breaker.
 - c. Repair materials.
4. Statement of Qualification:
 - a. Batch Plant: Certification as specified herein.
 - b. Mix designer.
 - c. Installer.
 - d. Testing agency.
5. Manufacturer's written instructions for product shipment, storage, handling, installation/application, and repair for:
6. Waterstop.
7. Joint filler and primer.
8. Preformed control joint.
9. Concrete Delivery Tickets:
 - a. For each batch of concrete before unloading at Site.
 - b. In accordance with ASTM C94/C94M, including Requirement 14.2.1. through Requirement 14.2.10.
 - c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
3. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
4. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 - a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician—Grade I. Testing Agency laboratory

supervisor shall be an ACI-certified Concrete Laboratory Testing Technician–Grade II.

PART 2 PRODUCTS

2.01 GENERAL

- A. Unless otherwise specified, Work must be in accordance with ACI 301.

2.02 FORMWORK

- A. Form Materials:
 - 1. For exposed areas, use hard plastic finished plywood, overlaid waterproof particle board, or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.
 - 2. For unexposed areas, use new shiplap or plywood.
 - 3. Earth cuts may be used for forming footings.
- B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.
- C. Form Ties:
 - 1. Material: Steel.
 - 2. Spreader Inserts:
 - a. Conical or spherical type.
 - b. Design to maintain positive contact with forming material.
 - c. Furnish units that will leave no metal closer than 1-1/2 inches to concrete surface when forms, inserts, and tie ends are removed.
 - 3. Wire ties not permitted.

2.03 CONCRETE

- A. Materials:
 - 1. Cementitious Materials:
 - a. Cement:
 - 1) Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.
 - 2) Blended Hydraulic Cement:
 - a) Unless otherwise specified, excluding Type IS (greater than 70), conforming to ASTM C595/C595M.

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- b) Portland cement used in blended hydraulic cement; conform to requirements of ASTM C150/C150M.
- 3) Furnish from one source.
- b. Supplementary Cementitious Materials (SCM):
 - 1) Fly Ash (Pozzolan): Class F and Class C fly ash in accordance with ASTM C618, except as modified herein:
 - a) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
 - 2) Slag Cement: In accordance with ASTM C989/C989M, Grade 100 or Grade 120.
 - 3) Silica Fume: In accordance with ASTM C1240.
- 2. Aggregates: Unless otherwise permitted, furnish from one source for each aggregate type used in a mix design.
 - a. Aggregates:
 - 1) In accordance with ASTM C33/C33M, except as modified herein.
 - a) In accordance with ACI 301, except as modified herein.
 - b) Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
 - c) Aggregates that are susceptible to alkali-carbonate reactions shall not be used.
 - d) Alkali Silica Reactivity: See Paragraph Concrete Mix Design.
 - 2) Fine Aggregates:
 - a) In accordance with ASTM C33/C33M, except as modified herein.
 - b) In the event manufactured sand is included in the mix design, the material shall be from the same source as the coarse aggregate.
 - c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
 - (1) Limit material finer than 75- μ m (No. 200) sieve to 3 percent mass of total sample.
 - (2) Limit coal and lignite to 0.5 percent.
 - 3) Coarse Aggregate:
 - a) Crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles as determined by ASTM D4791.
 - b) Class designation in accordance with ASTM C33/C33M, Table 3: 4S unless otherwise specified.

- c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.
3. Admixtures:
- a. Characteristics:
 - 1) Compatible with other constituents in mix.
 - 2) Contain at most, only trace amount chlorides in solution.
 - 3) Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
 - b. Air-Entraining Admixture: ASTM C260/C260M.
 - c. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
 - d. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - e. Accelerating Admixture: ASTM C 494/C 494M, Type C.
 - f. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
 - g. Admixtures with no standard, ASTM or other, designation may be used where permitted.
4. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.
- a. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
 - 1) Chloride Content: 1,000 ppm.
 - 2) Sulfate Content as SO_4 : 3,000 ppm.
 - 3) Alkalis as $(Na_2O + 0.658 K_2O)$: 600 ppm.
 - 4) Total Solids by Mass: Less than 50,000 ppm.

B. Concrete Mix Design:

1. General:
- a. Unless otherwise specified, refer to Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
 - 1) Alternate product for small concrete placements:
 - a) Concrete product intended for use on small concrete placements, such as equipment pads, in full depth form and pour applications. Use shall be approved by the Owner. Not to be used in water holding applications.
 - b) One component cementitious concrete mix containing factory blended coarse aggregate.
 - c) Self-consolidating with maximum pour depth compatible with the required placement depth.

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- d) Contains integral corrosion inhibitor.
- e) Compressive Strength, ASTM C39: 28 days, 4,500 pounds per square inch minimum.
- f) Drying Shrinkage, ASTM C157/C157M at 28 Days
 - (1) 0.07 percent maximum.
 - (2) Chloride Ion Permeability Based on Charge Passed, ASTM C1202.
 - (3) 1,800 coulombs maximum.
- g) Manufacturers and Products:
 - (1) Master Builders Solutions, Shakopee, MN; MasterEmaco S 440CI.
 - (2) Euclid Chemical Co. Cleveland, OH; EucoRepair SCC.
 - (3) Sika Corp., Lyndhurst, NJ; Sikacrete 211 SCC Plus.
- b. Unless otherwise specified, prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301.
- c. Unless otherwise specified, selection of constituent materials and products in mix design are optional.
- d. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, or water-reducing admixture for the following:
 - 1) Pumped concrete.
 - 2) Concrete with a water-cementitious materials ratio below 0.50.
 - 3) Concrete mixtures used in walls.
 - 4) When needed to achieve fresh properties that facilitate handling, placing, and consolidating of concrete mixtures, and to achieve specified hardened properties.
 - 5) When anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
- e. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.
- f. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies such as use of supplementary cementitious materials and aggregate packing, and self-consolidating concrete.

2. Potential Alkali-Aggregate Reactivity of Concrete:
 - a. Do not use aggregates known to be susceptible to alkali-carbonate reaction (ACR).
 - b. Unless otherwise specified, or unless members are assigned to Exposure Class C0, use one of the three options below for qualifying concrete mixtures to reduce the potential of alkali-silica reaction. Option 3) shall not be used with natural pozzolans, or fly ash that has a CaO content more than 18 percent, or for aggregates with expansions greater than or equal to 0.24 percent when tested in accordance with ASTM C1293. Fly ash with an alkali content greater than 4 percent shall not be used in Option 2) or Option 3).
 - 1) For each aggregate used in concrete, the expansion result determined in accordance with ASTM C1293 shall not exceed 0.04 percent at 1 year.
 - 2) For each aggregate used in concrete, the expansion result of the aggregate and cementitious materials combination determined in accordance with ASTM C1567 shall not exceed 0.10 percent at an age of 16 days. Submit supporting data for each aggregate showing expansion in excess of 0.10 percent at 16 days when tested in accordance with ASTM C1260.
 - 3) Alkali content in concrete (LBA), excluding that from supplementary cementitious materials and the pozzolans and slags in blended cements, shall not exceed 4 pounds per cubic yard for aggregates with expansions more than or equal to 0.04 percent and less than 0.12 percent or 3 pounds per cubic yard for aggregates with expansions greater than or equal to 0.12 percent and less than 0.24 percent. Reactivity shall be determined by testing in accordance with ASTM C1293. Alkali content shall be calculated as follows:
 - a) $LBA = (\text{cement content, lb/yd}^3) \times (\text{equivalent alkali content of portland cement in percent}/100 \text{ percent}).$
3. Proportions:
 - a. Design mix to meet aesthetic, durability, and strength requirements.
 - b. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent of weight of total cementitious materials.
 - c. Where silica fume is included in mix, minimum silica fume content shall be 5 percent of weight of total cementitious materials.

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4. Slump:
 - a. Unless otherwise specified, and prior to submitting mix design, select a target slump at the point of delivery for concrete mixtures used for Work. Selected target slump shall not exceed 9 inches. Concrete shall not show visible signs of segregation. The target slump indicated on the submittal shall be used as the basis for acceptance during the project. Determine the slump by ASTM C143/C143M.
 - b. Slump tolerance shall meet requirements of ACI 117.
5. Size of Coarse Aggregate:
 - a. Unless otherwise specified, nominal maximum size of coarse aggregate shall not exceed:
 - 1) Three-fourths of minimum clear spacing between reinforcement.
 - 2) One-fifth of narrowest dimension between sides of forms.
 - 3) One-third of thickness of slabs or toppings.
6. Temperature Limits: Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set, plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.

2.04 REINFORCING STEEL

- A. Deformed Steel Reinforcing Bars: ASTM A615/A615M, Grade 60. Welding of reinforcing bars is not permitted.
- B. Fabrication: Follow CRSI Manual of Standard Practice.

2.05 ANCILLARY MATERIALS

- A. Bonding Agent:
 1. Unless otherwise specified, in accordance with the following:
 - a. ASTM C881/C881M, Type V.
 - b. Two-component, moisture-insensitive, 100 percent solids epoxy.
 - c. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
 - d. Manufacturers and Products:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject 1500.
 - 2) Euclid Chemical Co., Cleveland, OH; Euco No. 352 Epoxy System LV.

- 3) Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
- 4) Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.

B. Bond Breaker:

1. Nonstaining type, providing positive bond prevention.
2. Manufacturers and Products:
 - a. Dayton Superior Corporation, Miamisburg, OH; Sure Lift J6WB.
 - b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.

C. Reinforcing Steel Accessories:

1. Plastic Protected Wire Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Class 1 Reinforcement Supports.
2. Stainless Steel Protected Wire Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Class 2 Reinforcement Supports, except legs shall be made wholly from stainless steel wire.
3. Precast Concrete Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Cementitious (Precast) Reinforcement Supports.
 - a. Precast concrete bar supports shall have equal or greater strength than the surrounding concrete.
 - b. Precast concrete bar supports shall be four square inches minimum, in plan.
 - c. Precast concrete bar supports shall have tie wires.

D. Tie Wire:

1. Black, soft-annealed 16-gauge wire.
2. Nylon-coated, epoxy-coated, or plastic-coated wire.

E. Hydrophilic Waterstop:

1. For use at construction joints only, where new concrete is placed against existing concrete and as shown on the Drawings.
2. Material shall be a nonbentonite hydrophilic rubber compound.
3. Manufacturers and Products:
 - a. Greenstreak Plastic Products, St. Louis, MO; Hydrotite CJ-1020-2K with Leakmaster LV-1 adhesive and sealant.
 - b. Adeka Ultra Seal, JLM Associates, Spearfish, SD; MC-2010M with 3M-2141 adhesive and P-201 sealant.

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F. Premolded Joint Filler:

1. Bituminous Type: ASTM D994/D994M or ASTM D1751.
2. Sponge Rubber:
 - a. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 pounds per square inch to 24 pounds per square inch) minimum.
 - b. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK515IHD.

G. Curing Compound:

1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.
2. Manufacturers and Products:
 - a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
 - b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
 - c. Vexcon Chemical, Inc., Philadelphia, PA; Starseal 1315.
 - d. Dayton Superior; Safe Cure and Seal 1315 EF.

H. Nonshrink Grout:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Test in accordance with ASTM C1107/C1107M:
 - a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
 - b. Temperatures of 40 degrees F, 80 degrees F, and 100 degrees F.
5. Pass fluid grout through flow cone with continuous flow 1-hour after mixing.
6. Minimum Strength of Fluid Grout:
 - a. 3,500 pounds per square inch at 1 day.
 - b. 4,500 pounds per square inch at 3 days.
 - c. 7,500 pounds per square inch at 28 days.
7. Maintain fluid consistency when mixed in 1 yard to 9 yard loads in ready-mix truck.
8. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterFlow 928.
 - b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.

- c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
- d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.

I. Repair Material:

- 1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
- 2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
- 3. Obtain Manufacturer's Certificate of Compliance that products selected are appropriate for specific applications.
- 4. Repair mortar shall be Site mixed.
- 5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
- 6. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterEmaco S Series products.
 - b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop Series.

2.06 SOURCE QUALITY CONTROL

- A. Source Quality Control Inspection: The Owner shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and subcontractors, providing products included in this section.

PART 3 EXECUTION

3.01 FORMWORK

A. Form Construction:

- 1. Construct forms and provide smooth-form finish.
- 2. Form 3/4-inch bevels at concrete edges, unless otherwise shown.
- 3. Make joints tight to prevent escape of mortar and to avoid formation of fins.
- 4. Brace as required to prevent distortion during concrete placement.
- 5. On exposed surfaces, locate form ties in uniform pattern or as shown.
- 6. Construct so ties remain embedded in the member with no metal within 1-inch of concrete surface when forms, inserts, and tie ends are removed.

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B. Form Removal:

1. Nonsupporting forms (walls and similar parts of Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
 - a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
 - b. Curing and protection operations are maintained.
2. Remove forms with care to prevent scarring and damaging the surface.
3. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

3.02 PLACING REINFORCING STEEL

A. Unless otherwise specified, in accordance with ACI 301.

B. Accessories:

1. Bar Supports in Contact with Ground: Provide precast concrete block supports.
 - a. Do not use brick, broken concrete masonry units, spalls, rocks, construction debris, or similar material for supporting reinforcing steel.
2. Bar Supports in Contact with Forms: Unless otherwise noted, bar supports shall be plastic protected wire bar supports, stainless steel protected wire bar supports, or precast concrete block bar supports.
 - a. Use stainless steel protected wire bar supports or precast concrete block bar supports at formed surfaces that will receive abrasive blasting, hydro-blasting, or grinding.
3. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports, and location of reinforcement remains within tolerance throughout work.

C. Splices and Laps:

1. Lap Splice Reinforcing: Refer to Structural General Notes on the Drawings for additional information.
2. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 INSTALLATION OF WATERSTOPS

A. General:

1. Continuous waterstop, as specified, shall be installed in all construction joints in walls and slabs of water holding basins and channels and in walls of belowgrade structures, unless specifically noted otherwise.
2. Join waterstop at intersections to provide continuous seal.
3. Center waterstop on joint.
4. Secure waterstop in correct position. Tie waterstop to reinforcing steel using grommets, hog rings, or tie wire at maximum spacing of 12 inches. Do not displace waterstop during concrete placement.
5. Repair or replace damaged waterstop.
6. Place concrete and vibrate to obtain impervious concrete in vicinity of joints.
7. Joints in Footings and Slabs:
 - a. Ensure space beneath plastic waterstop is completely filled with concrete.
 - b. Make visual inspection of waterstop area during concrete placement.
 - c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, then place remaining concrete to full height of slab.
8. Hydrophilic Waterstop:
 - a. Prepare concrete surfaces and install in accordance with waterstop manufacturer's written instructions and the following:
 - 1) Surface Preparation:
 - a) Concrete surface must be smooth, clean, and dry. Grind concrete as required.
 - b) Clean debris, dirt, dust, and foreign material from concrete surface.
 - 2) Installation:
 - a) Provide minimum of 2-1/2 inches of concrete cover over waterstop. When structure has two layers of steel reinforcement, locate centered between layers of steel or as shown.
 - b) Apply adhesive to concrete surface and allow to dry for specified time before applying waterstop strip.
 - c) Lap ends of waterstop strip together at splices and corners and join with sealant.

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- d) Verify that waterstop is anchored firmly in place before placing concrete. Do not allow vibrator to come into contact with waterstop.
- e) Lap hydrophilic waterstop 2 feet minimum with intersecting plastic waterstops.

3.04 CONCRETE PLACEMENT INTO FORMWORK

- A. Inspection: Notify the Owner at least 1-work day in advance before starting to place concrete.
- B. Placement into Formwork:
 - 1. Reinforcement: Secure in position before placing concrete.
 - 2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs that shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
 - 3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
 - 4. Use means and methods that prevent segregation.
 - 5. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
 - 6. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
- C. Retempering: Not permitted for concrete where cement has partially hydrated.
- D. Pumping of Concrete:
 - 1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
 - 2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
 - 3. Replace pumping equipment and hoses (conduits) that are not functioning properly.
- E. Maximum Size of Concrete Placements:
 - 1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
 - 2. Locate expansion, control, and contraction, joints where shown.

3. Construction Joints:
 - a. Unless otherwise shown or permitted, locate construction joints as follows:
 - 1) Locate construction joints as shown on the Drawings or where approved in the joint location submittal.
 - 2) Locate expansion, control, and contraction joints where shown on the Drawings.
 - 3) Provide vertical construction joints at maximum spacing of 40 feet unless shown or approved otherwise.

F. Minimum Time between Adjacent Placements:

1. Typical Unless Noted Otherwise: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
2. Expansion or Contraction Joints: 1-day.

3.05 CONSOLIDATION AND VISUAL OBSERVATION

- A. Provide at least one standby vibrator in operable condition at placement site prior to placing concrete.

3.06 CONCRETE BONDING

- A. Construction Joints at Existing Concrete:
 1. Thoroughly clean and roughen existing concrete surfaces to roughness profile range between CSP 7 to CSP 9 when verified by comparison to PC1-10.
 2. Saturate surface with water for 24 hours prior to placing new concrete.

3.07 PREMOLDED JOINT FILLER INSTALLATION

- A. Sufficient in width to completely fill joint space where shown.
- B. Drive nails approximately 1 foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.
- C. Secure premolded joint filler in forms before concrete is placed.

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3.08 FINISHING FORMED SURFACES

- A. Provide surface finish 2.0 (SF-2.0) in accordance with ACI 301 and as herein specified.
- B. Tie Holes:
 - 1. Unless otherwise specified, fill with specified repair material.
 - a. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.
- C. Repair defective areas of concrete.
 - 1. Cut edges perpendicular to surface at least 1/2-inch deep. Do not feather edges. Soak area with water for 24 hours.
 - 2. Patch with specified repair material.
 - 3. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from the Owner prior to use.
 - 4. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from the Owner.
 - 5. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
 - 6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to the Owner.
- D. Inject cracks that meet the definition of defective area.
 - 1. When crack repair is deemed by the Owner as requiring a structural repair, use part epoxy injection resin.
 - 2. When crack repair is deemed by the Owner as requiring a nonstructural repair, use hydrophilic polyurethane injection resin.

3.09 FINISHING UNFORMED SURFACES

A. General:

1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
2. Do not use “jitterbugs” or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
3. Do not dust surfaces with dry materials nor add water to surfaces.
4. Cure concrete as specified.

B. Slab Tolerances:

1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
3. Steel gauge block 5/16-inch thick.
4. Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
5. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2-inch plus.

C. Interior Slab Finish: Provide trowel finish unless specified otherwise.

D. Exterior Slab Finish:

1. Provide broom finish unless specified otherwise.
2. Finish exposed edges with steel edging tool.
3. Mark sidewalks transversely at 5-foot intervals with jointing tool.

3.10 EXPOSED METAL OBJECTS

- A. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1-inch and then cutting or removing metal object.
- B. Repair area of chipped-out concrete as specified for defective areas.

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3.11 BLOCKOUTS AT PIPES OR OTHER PENETRATIONS

- A. Where shown, install in accordance with requirements of Drawings.

3.12 PROTECTION AND CURING

- A. Protect and cure concrete in accordance with requirements of ACI 301, ACI SPEC 308.1, External Curing of Cast-In-Place Concrete—Specification, and as follows:
1. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
 2. Continuously wet cure concrete surfaces of hydraulic structures for a 7-day period. Intermittent wetting is not acceptable.
 3. Use curing compound only where approved by the Owner.
 4. Cure formed surfaces with curing compound applied in accordance with manufacturer's written instructions as soon as wet curing and finishing are completed.
 5. Remove and replace concrete damaged by freezing.
 6. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.13 NONSHRINK GROUT

- A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer's written instructions.
- B. Grouting Machinery Foundations:
1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.
 2. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.
 3. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.
 4. Form with watertight forms at least 2 inches higher than bottom of plate.
 5. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's written instructions.

3.14 BACKFILL AGAINST STRUCTURES

- A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.
- B. Refer to General Structural Notes on the Drawings for additional requirements, including elevated slab and diaphragm completion prior to backfill.
- C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.15 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. General:
 - 1. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours and for additional time as may be required before transporting to test lab.
 - 2. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
 - 3. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
 - 4. Evaluation will be in accordance with ACI 301 and Specifications.
 - 5. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
 - 6. Frequency of testing may be changed at discretion of the Owner.
 - 7. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M.
 - 8. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.

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B. Concrete Strength Test:

1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing by 7 additional days.
3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by the Owner.
4. Segregation Test Objective: Concrete shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump or slump flow test.
 - a. Test Procedure: Make slump or slump flow test and check for excessive slump or slump flow. Observe to see if mortar or moisture flows from slumped concrete.
 - b. Reject concrete if mortar or moisture separates and flows out of mix.

C. Slab Finish Tolerances and Slope Tolerances:

1. Support 10-foot-long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
2. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

3.16 MANUFACTURER'S SERVICES

A. Provide representative at Site for installation assistance, inspection, and certification of proper installation for concrete ingredients, mix design, mixing, and placement.

B. Concrete Producer Representative:

1. Observe how concrete mixes are performing.
2. Assist with concrete mix design, performance, placement, weather problems, and problems as may occur with concrete mix throughout Project, including instructions for redosing.
3. Establish control limits on concrete mix designs.
4. Provide equipment for control of concrete redosing for air entrainment or high-range, water-reducing admixture, superplasticizers, at Site to maintain proper slump or slump flow, and air content when specified.

C. Admixture Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

- D. Bonding Agent Manufacturer's Representative: Available for consultations as required to ensure proper installation and performance of specified products.

3.17 SUPPLEMENT

- A. Requirements of concrete mix designs following "End of Section," are a part of this specification:
 - 1. Concrete Mix Design, Class 4500F0S1P0C1.

END OF SECTION

CONCRETE MIX DESIGN, CLASS 4500F0S1P0C1

- A. Mix Locations: Where specified in Contract Documents.
- B. Exposure Categories and Classifications: F0S1P0C1.
- C. Mix Properties:
 - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.45.
 - 2. Minimum concrete compressive strength (f'c) shall be 4,500 psi at 28 days.
 - a. Designed to conform to shrinkage limits.
 - b. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
 - 1) Slabs to receive a hard-troweled finish.
 - 2) Slabs to receive a dry shake floor hardener.
 - 3) Slabs to receive a topping placed monolithically as a two-course floor on top of plastic concrete.
 - c. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2§	5.0

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Nominal Maximum Aggregate Size in. ‡	Air Content (%)*
3§	4.5
‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations. *Tolerance of air content is $\pm 1-1/2$ percent. §Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on sieved fraction passing 1-1/2-inch sieve in accordance with ASTM C231/C231M.	

3. Provide cementitious materials in accordance with one of the following:
 - a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
 - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
 - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
 - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
 - 3) ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
4. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent, unless otherwise specified.
 - a. Limits are stated in terms of chloride ions in percent by weight of cement.
 - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.

D. Refer to Part 1 through Part 3 of this section for additional requirements.

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Water Works Association (AWWA):
 - a. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines—Enamel and Tape—Hot-Applied.
 - b. C209, Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
 - c. C213, Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
 - d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
 2. Environmental Protection Agency (EPA).
 3. NACE International (NACE): SP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
 4. NSF International (NSF): 61, Drinking Water System Components-Health Effects.
 5. Occupational Safety and Health Act (OSHA).
 6. Research Council on Structural Connections (RCSC): Specification for Structural Joints using High-Strength Bolts.
 7. The Society for Protective Coatings (SSPC):
 - a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
 - b. PA 10, Guide to Safety and Health Requirements for Industrial Painting Projects.
 - c. SP 1, Solvent Cleaning.
 - d. SP 2, Hand Tool Cleaning.
 - e. SP 3, Power Tool Cleaning.
 - f. SP 5, White Metal Blast Cleaning.
 - g. SP 6, Commercial Blast Cleaning.
 - h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
 - i. SP 10, Near-White Blast Cleaning.
 - j. SP 11, Power Tool Cleaning to Bare Metal.
 - k. SP 16, Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.

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- l. SP 13, Surface Preparation of Concrete.
- m. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
6. Mil: Thousandth of an inch.
7. PPDS: Paint Product Data Sheet.
8. PSDS: Paint System Data Sheet.
9. PVC: Polyvinyl Chloride.
10. SFPG: Square Feet per Gallon.
11. SFPGPC: Square Feet per Gallon per Coat.
12. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Data Sheets:
 - 1) For each product, furnish a Paint Product Data Sheet (PPDS), the manufacturer's technical data sheets, and paint colors available (where applicable).
 - 2) For each paint system, furnish a Paint System Data Sheet (PSDS).
 - 3) Technical and performance information that demonstrates compliance with specification.
 - 4) Furnish copies of paint system submittals to the coating applicator.
 - 5) Indiscriminate submittal of only manufacturer's literature is not acceptable.
 - b. Detailed chemical and gradation analysis for each proposed abrasive material.

2. Samples:
 - a. Proposed Abrasive Materials: Minimum 5-pound sample for each type.
 - b. Reference Panel:
 - 1) Surface Preparation:
 - a) Prior to start of surface preparation, furnish a 4-inch by 4-inch steel panel for each grade of sandblast specified herein, prepared to specified requirements.
 - b) Provide panel representative of the steel used; prevent deterioration of surface quality.
 - c) Panel to be reference source for inspection upon approval by Engineer.
 - 2) Paint:
 - a) Unless otherwise specified, before painting work is started, prepare minimum 8-inch by 10-inch sample with type of paint and application specified on similar substrate to which paint is to be applied.
 - b) Furnish additional samples as required until colors, finishes, and textures are approved.
 - c) Approved samples to be the quality standard for final finishes.

B. Informational Submittals:

1. Applicator's Qualification: List of references substantiating experience.
2. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services.
3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.
4. Manufacturer's written verification that submitted material is suitable for the intended use.
5. Coating for Faying Surfaces: Manufacturer's test results that show the proposed coating meets the slip resistance requirements of the AISC Specification for Structural Joints using ASTM A325 or ASTM A490 bolts.
6. If the manufacturer of finish coating differs from that of shop primer, provide finish coating manufacturer's written confirmation that materials are compatible.
7. Manufacturer's written instructions and special details for applying each type of paint.

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1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Minimum 5 years' experience in application of specified products.
- B. Regulatory Requirements:
 - 1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds.
 - 2. Perform surface preparation and painting in accordance with recommendations of the following:
 - a. Paint manufacturer's instructions.
 - b. SSPC PA 10.
 - c. Federal, state, and local agencies having jurisdiction.
- C. Mockup:
 - 1. Before proceeding with Work under this section, finish one complete space or item of each color scheme required showing selected colors, finish texture, materials, quality of work, and special details.
 - 2. After Engineer approval, sample spaces or items shall serve as a standard for similar work throughout the Project.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Shipping:
 - 1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
 - 2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.
- B. Storage:
 - 1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
 - 2. Primed surfaces shall not be exposed to weather for more than 2 months before being topcoated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.
- B. Minimum of 5 years' verifiable experience in manufacture of specified product.
- C. Each of the following manufacturers is capable of supplying most of the products specified herein:
 1. Akzo Nobel (Devoe, International).
 2. Carboline.
 3. PPG.
 4. Sherwin-Williams.
 5. Tnemec.

2.02 ABRASIVE MATERIALS

- A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

- A. General:
 1. Manufacturer's highest quality products suitable for intended service.
 2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.

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3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

Product	Definition
Epoxy Primer— Ferrous Metal	Anticorrosive, converted epoxy primer containing rust-inhibitive pigments
Epoxy Primer— Other	Epoxy primer, high-build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated
Fusion Bonded Coating	100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service
High Build Epoxy	Polyamidoamine epoxy, minimum 69 percent volume solids, capability of 4 to 8 MDFT per coat
NSF Epoxy	Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish

2.04 MIXING

A. Multiple-Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

- B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.05 SHOP FINISHES

- A. Shop Blast Cleaning: Reference Paragraph Shop Coating Requirements.
- B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.
- C. Shop Coating Requirements:
 - 1. When required by equipment specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
 - 2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.
- D. Pipe:
 - 1. Steel Pipe:
 - a. Surface preparation and application of primer and finish coats shall be performed by pipe manufacturer.
 - b. For pipe with epoxy lining, do not place end cap seals until pipe lining material has sufficiently cured.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide Engineer minimum 7 days' advance notice to start of field surface preparation work and coating application work.
- B. Perform the Work only in presence of Engineer, unless Engineer grants prior approval to perform the Work in Engineer's absence.
- C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Engineer.

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3.02 EXAMINATION

- A. Factory Finished Items:
 - 1. Schedule inspection with Engineer before repairing damaged factory-finished items delivered to Site.
 - 2. Repair abraded or otherwise damaged areas on factory-finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.
- B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.
- B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.
- D. Mask openings in motors to prevent paint and other materials from entering.
- E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

- A. Field Abrasive Blasting:
 - 1. Perform blasting for items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed or coated.
 - 2. Refer to coating systems for degree of abrasive blasting required.
 - 3. Where the specified degree of surface preparation differs from manufacturer's recommendations, the more stringent shall apply.

B. Surface Contamination Testing:

1. A surface contamination analysis test shall be performed every 500 square feet by means of a Chlor Test CSN Salts, “or-equal.”
2. Surfaces with chloride levels exceeding 3 µg/square centimeter for submerged surfaces and 5 µg/centimeter for exposed surfaces shall be treated with a liquid soluble salt remover equivalent to CHLOR*RID (CHLOR*RID International, Chandler, AZ).
3. Follow manufacturer’s recommendations and procedures for the use of this product to remove the surface contamination.

C. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:
 - a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.
 - b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.
 - c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power-assisted hand tools.
 - d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.
 - e. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
 - f. SP 7, Brush-Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.

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- g. SP 10, Near-White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.
 - h. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power-assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.
 - i. SP 16, Brush Blasting of Non-Ferrous Metals: A brush-off blast cleaned non-ferrous metal surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, metal oxides (corrosion products), and other foreign matter. Intact, tightly adherent coating is permitted to remain. A coating is considered tightly adherent if it cannot be removed by lifting with a dull putty knife. Bare metal substrates shall have a minimum profile of 19 micrometers (0.75 mil).
- 2. The words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” and “blast cleaning,” or similar words of equal intent in these Specifications or in paint manufacturer’s specification refer to the applicable SSPC Specification.
 - 3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu-blast methods may be required. Coating manufacturers’ recommendations for wet blast additives and first coat application shall apply.
 - 4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.
 - 5. Hand tool clean areas that cannot be cleaned by power tool cleaning.
 - 6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.
 - 7. Welds and Adjacent Areas:
 - a. Prepare such that there is:
 - 1) No undercutting or reverse ridges on weld bead.
 - 2) No weld spatter on or adjacent to weld or any area to be painted.
 - 3) No sharp peaks or ridges along weld bead.
 - b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

8. Preblast Cleaning Requirements:
 - a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.
 - b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.
 - c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.
9. Blast Cleaning Requirements:
 - a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.
 - b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.
 - c. Use only dry blast cleaning methods.
 - d. Do not reuse abrasive, except for designed recyclable systems.
 - e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.
10. Post-Blast Cleaning and Other Cleaning Requirements:
 - a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.
 - b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

3.05 SURFACE CLEANING

A. Brush-off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.
2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.
3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.
4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.

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5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.
6. Repair or replace surface damaged by blast cleaning.

B. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.
2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. The intention of these Specifications is for new, interior and exterior metal, and submerged metal surfaces to be painted, whether specifically mentioned or not, except as specified otherwise.
2. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.
3. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.
4. Apply coatings in accordance with these Specifications and paint manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.
5. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
6. Fusion Bonded Coatings Method Application: Electrostatic, fluidized bed, or flocking.
7. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.
8. Keep paint materials sealed when not in use.
9. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Film Thickness and Coverage:

1. Number of Coats:
 - a. Minimum required without regard to coating thickness.
 - b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
 - a. Do not exceed coating manufacturer's recommendations.
 - b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
 - a. Perform with properly calibrated instruments.
 - b. Recoat and repair as necessary for compliance with specification.
 - c. Coats are subject to inspection by Engineer and coating manufacturer's representative.
4. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
5. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

- A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

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B. System No. 1 Submerged Metal—Potable Water:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	NSF Epoxy	3 coats, 3 MDFTPC

1. Use on the following items or areas:
 - a. Metal surfaces new and below a plane 1-foot above the maximum liquid surface; metal surfaces above the maximum liquid surface that are a part of the immersed equipment; surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gate guides and thimbles, and structural steel that are embedded in concrete; and the following specific surfaces:
 - 1) Interior lining of steel pipe where specifically required to be epoxy lined.

C. System No. 4 Exposed Metal—Highly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Epoxy Primer— Ferrous Metal	1 coat, 2.5 MDFT
	High Build Epoxy	1 coat, 4 MDFT
	Polyurethane Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:
 - a. Exposed metal surfaces, new and existing located inside of vaults or structures. This includes bolts (head and tail), nuts, tie-rod threads, and valves the same color as the waterline.
 - b. All coatings to be applied in the shop and repaired in the field.

D. System No. 7 Concrete Encased Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	High Build Epoxy	2 coats, 16 MDFT

1. Use on the following items or areas:
 - a. Concrete encased surfaces of ferrous metals, including wall pipes, pipe sleeves, and access manholes, not specified to be coated with another system.

E. System No. 29 Fusion Bonded Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Fusion Bonded Coating 100 percent Solids Epoxy	1 or 2 coats, 7 MDFT

1. For steel pipe and fittings, meet all requirements of AWWA C213.
2. Use on the following items:
 - a. As an alternative external coating for items located inside vaults or structures.

F. System No. 29A Fusion Bonded, Steel Dowel Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near-White Blast Cleaning	Fusion Bonded Coating 100 percent Solids Epoxy	1 or 2 coats, 7 MDFT

1. Use as indicated in individual product specifications for steel pipe, fittings and appurtenances, and items to meet all requirements of AWWA C213.

3.08 COLORS

- A. Provide as selected by Owner or Engineer.
- B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.
- C. Equipment Colors:
 1. Paint equipment and piping one color as selected.
 2. Paint nonsubmerged portions of equipment the same color as the piping it serves, except as itemized below:
 - a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
 - b. Fire Protection Equipment and Apparatus: OSHA Red.
 - c. Radiation Hazards: OSHA Purple.
 - d. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

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3.09 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide calibrated electronic type dry film thickness gauge to test coating thickness specified in mils.
2. Provide low-voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high-build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide high-voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
 - a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC PA 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.
 - b. All coatings subject to immersion service shall be holiday tested on 100 percent of the coated surface.
 - c. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE SP0188.
 - d. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE SP0188.
 - e. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.

2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
2. Remove rust and contaminants from metal surface. Provide surface cleanliness and profile in accordance with surface preparation requirements for specified paint system.
3. Feather edges and repair in accordance with recommendations of paint manufacturer.
4. Apply finish coats, including touchup and damage-repair coats in a manner that will present a uniform texture and color-matched appearance.

3.10 CLEANUP

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.
- B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.
- C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

END OF SECTION

SECTION 26 05 02
BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. Z535.4, Product Safety Signs and Labels.
 - 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.03 DESIGN REQUIREMENTS

- A. Provide anchorage and bracing design drawings, calculations, and related information where required by the structural engineer.
- B. Provide seismic certification per requirements of the structural engineer, where required in that section for electrical equipment listed.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Provide manufacturers' data for the following:
 - a. Electrical service components.
 - b. Telephone service components.
 - c. Nameplates, signs, and labels.
 - 2. Anchorage and bracing drawings and catalog information, as required by the structural engineer.
- B. Informational Submittals: Anchorage and bracing calculations, as required by the structural engineer.

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1.05 QUALITY ASSURANCE

- A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark or label.
- C. Provide materials and equipment acceptable to AHJ for Class, Division, and Group of hazardous area indicated.

1.06 ENVIRONMENTAL CONDITIONS

- A. The following areas are classified nonhazardous and wet. Use materials and methods required for such areas.
 - 1. Outdoor abovegrade areas not covered above.
 - 2. Equipment Room in UV Disinfection Building.
 - 3. Belowgrade vaults.
 - 4. Screen rooms.
- B. The following areas are classified as indoor and dry:
 - 1. Administration and Laboratory Building.
 - 2. Electrical Room.
- C. The following areas are not classified. Use dust-tight and oil-tight NEMA 12 materials and methods.
 - 1. Areas not covered above.

PART 2 PRODUCTS

2.01 GENERAL

- A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.

- C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated by the Owner.
- D. Electrical ratings of materials and equipment that are reduced by increased elevation shall be derated as required for Site elevation specified by the Owner.

2.02 EQUIPMENT FINISH

- A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with Section 09 90 00, Painting and Coating, as approved by Engineer.

2.03 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment Screws:
 - 1. Stainless steel.
 - 2. Adhesive: Single-part, room temperature vulcanizing adhesive suitable for the environment and materials installed. Use adhesive on NEMA 4 or NEMA 4X enclosures only.
- C. Color: White, engraved to a black core.
- D. Letter Height:
 - 1. Pushbuttons/Selector Switches: 1/8-inch.
 - 2. Other Electrical Equipment: 1/4-inch.

2.04 SIGNS AND LABELS

- A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.

PART 3 EXECUTION

3.01 GENERAL

- A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.
- B. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on the Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.
- C. Install work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Keep openings in boxes and equipment closed during construction.
- E. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.

3.02 ANCHORING, BRACING, AND MOUNTING

- A. Equipment anchoring and mounting shall be in accordance with manufacturer's requirements for Project design criteria provided by the Owner, to meet the requirements of the structural engineer.

3.03 COMBINING CIRCUITS INTO COMMON RACEWAY

- A. Drawings show each homerun circuit to be provided. Do not combine power or control circuits into common raceways without authorization of Engineer.

3.04 NAMEPLATES, SIGNS, AND LABELS

A. Arc Flash Protection Warning Signs:

1. Field mark switchboards, motor control centers, panelboards to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.
2. Use arc flash hazard boundary, energy level, PPE level and description, shock hazard, bolted fault current, and equipment name from study required in Section 26 05 70, Electrical Systems Analysis, as basis for warning signs.

B. Available Fault Current Signs:

1. Install label on service equipment to indicate the maximum available fault current at the equipment. Labels shall be of sufficient durability for the environment in which the equipment is installed. Labels shall include the following information:
 - a. Equipment name or identification.
 - b. Available fault current at the equipment.
 - c. Date the fault current calculations were performed.
2. Use bolted fault current and equipment name from study required in Section 26 05 70, Electrical Systems Analysis, as basis for the label.
3. Where existing electrical systems are modified, completely remove existing fault current labels if present, and install new labels in accordance with the above requirements.

C. Equipment Nameplates:

1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

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3.05 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.06 CLEANING AND TOUCHUP PAINTING

- A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.
- B. Touchup Paint:
 - 1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.
 - 2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.07 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.
- B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

SECTION 26 05 04
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
 - b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
 2. Canadian Standards Association (CSA).
 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
 4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C12.1, Code for Electricity Metering.
 - c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
 - d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 7. UL:
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 810, Standard for Capacitors.

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- g. 943, Standard for Ground-Fault Circuit-Interruption.
- h. 1059, Standard for Terminal Blocks.
- i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Provide manufacturers' data for the following:
 - a. Control devices.
 - b. Control relays.
 - c. Circuit breakers.
 - d. Fused switches.
 - e. Fuses.
 - f. Enclosures: Include enclosure data for products having enclosures.
- 2. Seismic anchorage and bracing drawings and cut sheets.

B. Informational Submittals: Seismic anchorage and bracing calculations.

1.03 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

- 1. Fuses, 0-Volt to 600 Volts: Six of each type and each current rating installed.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. General:

- 1. Type: Molded case.
- 2. Trip Ratings: 15 amps to 800 amps.
- 3. Voltage Ratings: 120V ac, 240V ac, 277V ac, 480V ac, and 600V ac.
- 4. Suitable for mounting and operating in any position.
- 5. UL 489.

B. Operating Mechanism:

- 1. Overcenter, trip-free, toggle type handle.
- 2. Quick-make, quick-break action.

3. Locking provisions for padlocking breaker in OPEN position.
 4. ON/OFF and TRIPPED indicating positions of operating handle.
 5. Operating handle to assume a CENTER position when tripped.
- C. Trip Mechanism:
1. Individual permanent thermal and magnetic trip elements in each pole.
 2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
 3. Two and three pole, common trip.
 4. Automatically opens all poles when overcurrent occurs on one pole.
 5. Test button on cover.
 6. Calibrated for 40 degrees C ambient, unless shown otherwise.
 7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.
- D. Short Circuit Interrupting Ratings: Equal to, or greater than, available fault current or interrupting rating shown.
- E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025-second (UL 943, Class A sensitivity, for protection of personnel).
1. Ground fault sensor shall be rated same as circuit breaker.
 2. Push-to-test button.
- F. Magnetic Only Type Breakers: Where shown; instantaneous trip adjustment which simultaneously sets magnetic trip level of each individual pole continuously through a 3X to 10X trip range.
- G. Accessories: Shunt trip, auxiliary switches, handle lock ON devices, mechanical interlocks, key interlocks, unit mounting bases, double lugs as shown or otherwise required. Shunt trip operators shall be continuous duty rated or have coil-clearing contacts.
- H. Connections:
1. Supply (line side) at either end.
 2. Mechanical wire lugs, except crimp compression lugs where shown.
 3. Lugs removable/replaceable for breaker frames greater than 100 amperes.

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4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
 5. Use bolted bus connections, except where bolt-on is not compatible with existing breaker provisions.
- I. Enclosures for Independent Mounting:
1. See Article Enclosures.
 2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
 3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.02 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

- A. UL 98 listed for use and location of installation.
- B. NEMA KS 1.
- C. Short Circuit Rating: 200,000 amps rms symmetrical with Class R, Class J, or Class L fuses installed.
- D. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- E. Connections:
1. Mechanical lugs, except crimp compression lugs where shown.
 2. Lugs removable/replaceable.
 3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.
- F. Fuse Provisions:
1. 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.
 2. 601-amp rated and greater shall accept Class L fuses, unless otherwise shown.
- G. Enclosures: See Article Enclosures.
- H. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.03 FUSE, 250-VOLT AND 600-VOLT

A. Power Distribution, General:

1. Current-limiting, with 200,000 ampere rms interrupting rating.
2. Provide to fit mountings specified with switches.
3. UL 248.

B. Power Distribution, Ampere Ratings 1-Amp to 600 Amps:

1. Class: RK-1.
2. Type: Dual element, with time delay.
3. Manufacturers and Products:
 - a. Bussmann; Types LPS-RK (600 volts) and LPN-RK (250 volts).
 - b. Littelfuse; Types LLS-RK (600 volts) and LLN-RK (250 volts).

C. Power Distribution, Ampere Ratings 601 Amps to 6,000 Amps:

1. Class: L.
2. Double O-rings and silver links.
3. Manufacturers and Products:
 - a. Bussmann; Type KRP-C.
 - b. Littelfuse, Inc.; Type KLPC.

D. Cable Limiters:

1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
2. Manufacturer and Product: Bussmann; K Series.

E. Ferrule:

1. 600V or less, rated for applied voltage, small dimension.
2. Ampere Ratings: 1/10-amp to 30 amps.
3. Dual-element time-delay, time-delay, or nontime-delay as required.
4. Provide with blocks or holders as indicated and suitable for location and use.
5. Manufacturers:
 - a. Bussmann.
 - b. Littelfuse, Inc.

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2.04 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.
- B. Selector Switch Operating Lever: Standard.
- C. Indicating Light: LED, full voltage.
- D. Pushbutton Color:
 - 1. ON or START: Black.
 - 2. OFF or STOP: Red.
- E. Pushbutton and selector switch lockable in OFF position where indicated.
- F. Legend Plate:
 - 1. Material: Aluminum.
 - 2. Engraving: Enamel filled in high contrasting color.
 - 3. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
 - 4. Letter Height: 7/64-inch.
- G. Manufacturers and Products:
 - 1. Heavy-Duty, Oil-Tight Type:
 - a. GE Vernova; Type CR 104P.
 - b. Schneider Electric; Type T.
 - c. Eaton; Type 10250T.
 - 2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
 - a. Schneider Electric; Type SK.
 - b. GE Vernova; Type CR 104P.
 - c. Eaton; Type E34.
 - d. Crouse-Hinds; Type NCS.

2.05 TERMINAL BLOCK, 600 VOLTS

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.

- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.
- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals:
 - 1. Capable of wire connections without special preparation other than stripping.
 - 2. Capable of jumper installation with no loss of terminal or rail space.
 - 3. Individual, rail mounted.
- I. Marking system, allowing use of preprinted or field-marked tags.
- J. Manufacturers:
 - 1. Weidmuller, Inc.
 - 2. Ideal.
 - 3. Electrovert USA Corp.

2.06 SUPPORT AND FRAMING CHANNELS

- A. Carbon Steel Framing Channel:
 - 1. Material: Rolled, mild strip steel, 12-gauge minimum, ASTM A1011/A1011M, Grade 33.
 - 2. Finish: Hot-dip galvanized after fabrication.
- B. Paint Coated Framing Channel: Carbon steel framing channel with electro-deposited rust inhibiting acrylic or epoxy paint.
- C. PVC-Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.
- D. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.
- E. Extruded Aluminum Framing Channel:
 - 1. Material: Extruded from Type 6063-T6 aluminum alloy.
 - 2. Fittings fabricated from Alloy 5052-H32.

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F. Nonmetallic Framing Channel:

1. Material: Fire retardant, fiber reinforced vinyl ester resin.
2. Channel fitting of same material as channel.
3. Nuts and bolts of long glass fiber reinforced polyurethane.

G. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.

2.07 ENCLOSURES

- A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.
- B. Color: Manufacturer’s standard color (gray) baked-on enamel, unless otherwise shown.
- C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.
- D. Enclosure Selections:
 1. Except as shown otherwise, provide electrical enclosures according to the following table:

Enclosures			
Location	Finish	Environment	NEMA 250 Type
Indoor	Finished	Dry	1
Indoor	Unfinished	Dry	1
Indoor	Unfinished	Industrial Use	12
Indoor and Outdoor	Any	Wet	4
Indoor and Outdoor	Any	Denoted “WP”	3R
Indoor and Outdoor	Any	Wet, Dust or Oil	13

PART 3 EXECUTION

3.01 GENERAL

- A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

- A. Install heavy-duty, oil-tight type in nonhazardous, indoor, dry locations, including motor control centers, control panels, and individual stations, unless otherwise shown.
- B. Install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas, unless otherwise shown.

3.03 SUPPORT AND FRAMING CHANNEL

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel Type:
 - 1. Interior, Wet or Dry (Noncorrosive) Locations:
 - a. Aluminum Raceway: Extruded aluminum or carbon steel with neoprene material isolators.
 - b. PVC-Coated Conduit: PVC coated.
 - c. Steel Raceway and Other Systems Not Covered: Carbon steel or paint coated.
 - 2. Aluminum Railings: Devices mounted on aluminum railing shall use aluminum framing channel.
- C. Paint cut ends prior to installation with the following:
 - 1. Carbon Steel Channel: Zinc-rich primer.
 - 2. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
 - 3. Nonmetallic Channel: Epoxy resin sealer.
 - 4. PVC-Coated Channel: PVC patch.

END OF SECTION

SECTION 26 05 05
CONDUCTORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
 - b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2,500 V to 500,000 V.
4. Insulated Cable Engineer's Association, Inc. (ICEA):
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 - b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
 - c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
5. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.
 - b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
 - c. WC 70, Standard for Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.
 - d. WC 71, Standard for Nonshielded Cables Rated 2,001 Volts to 5,000 Volts for Use in the Distribution of Electric Energy.

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- e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- 6. 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.
- 7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
- 8. UL:
 - a. 13, Standard for Safety for Power-Limited Circuit Cables.
 - b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
 - c. 62, Standard for Safety for Flexible Cord and Cables.
 - d. 486A-486B, Standard for Safety for Wire Connectors.
 - e. 486C, Standard for Safety for Splicing Wire Connectors.
 - f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - g. 854, Standard for Safety for Service-Entrance Cables.
 - h. 1072, Standard for Safety for Medium-Voltage Power Cables.
 - i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - j. 1569, Standard for Safety for Metal-Clad Cables.
 - k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Product Data:
 - a. Wire and cable.
 - b. Wire and cable accessories.
 - c. Cable fault detection system.
- 2. Manufactured Wire Systems:
 - a. Product data.
 - b. Rating information.
 - c. Dimensional drawings.
 - d. Special fittings.

B. Informational Submittals:

- 1. Journeyman lineman or electrician splicing credentials.
- 2. Factory Test Report for conductors 600 volts and below.

3. Factory Test Report per AEIC CS 8, including AEIC qualification report for conductors above 600 volts.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. All Circuits: Stranded copper.

C. Insulation: Type XHHW-2.

D. Direct Burial and Aerial Conductors and Cables:

1. Type USE/RHH/RHW insulation, UL 854 listed, or Type RHW-2/USE-2.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

E. Flexible Cords and Cables:

1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

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2.02 600-VOLT RATED CABLE

A. General:

1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 1, Multiconductor Control Cable:

1. Conductors:
 - a. 14 AWG, seven-strand copper.
 - b. Insulation: 15-mil PVC with 4-mil nylon.
 - c. UL 1581 listed as Type THHN/THWN rated VW-1.
 - d. Conductor group bound with spiral wrap of barrier tape.
 - e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.
2. Cable: Passes the ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:
 - a. Okonite Co.
 - b. Southwire.

C. Type 2, Multiconductor Power Cable:

1. General:
 - a. Meet or exceed UL 1581 for cable tray use.
 - b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
 - c. Overall Jacket: PVC.
2. Conductors:
 - a. Class B stranded, coated copper.
 - b. Insulation: Chemically cross-linked ethylene-propylene or cross-linked polyethylene.
 - c. UL rated VW-1 or listed Type XHHW-2.
 - d. Color Code:
 - 1) Conductors, size 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
 - 2) Conductors, size 6 AWG and larger, ICEA S-73-532, Method 4.
3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2	0.42	45
		3	0.45	
		4	0.49	
10	10	2	0.54	60
		3	0.58	
		4	0.63	
8	10	3	0.66	60
		4	0.75	
6	8	3	0.74	60
		4	0.88	
4	6	3	0.88	60
		4	1.04	
2	6	3	1.01	80
		4	1.16	
1	6	3	1.10	80
		4	1.25	

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Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
1/0	6	3 4	1.22 1.35	80
2/0	4	3 4	1.32 1.53	80
3/0	4	3 4	1.40 1.60	80
4/0	4	3 4	1.56 1.78	80 110

5. Manufacturers:
 - a. Okonite Co.
 - b. Southwire.

D. Type 3, 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.
3. Dimension: 0.31-inch nominal OD.
4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nominal nylon.
 - e. Color Code: Pair conductors, black and red.
5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.

- E. Type 4, 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57 requirements.
1. Outer Jacket: 45-mil nominal.
 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 3. Dimension: 0.32-inch nominal OD.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
 - b. 20 AWG, seven-strand, tinned copper drain wire.
 - c. Insulation: 15-mil nominal PVC.
 - d. Jacket: 4-mil nylon.
 - e. Color Code: Triad conductors black, red, and blue.
 5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.
- F. Type 5, 18 AWG, Multitwisted Shielded Pairs, with a Common Overall Shield, Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 57 requirements.
1. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
 - b. Tinned copper drain wires.
 - c. Pair drain wire size AWG 20, group drain wire size AWG 18.
 - d. Insulation: 15-mil PVC.
 - e. Jacket: 4-mil nylon.
 - f. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.
 - g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.
 2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

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3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers:

- a. Okonite Co.
- b. Alpha Wire Corp.
- c. Belden.

G. Type 6, 18 AWG, Multitwisted Pairs with Common Overall Shield
Instrumentation Cable: Designed for use as instrumentation, process control,
and computer cable meeting NEMA WC 57.

1. Conductors:

- a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
- b. Tinned copper drain wire size AWG 18.
- c. Insulation: 15-mil nominal PVC.
- d. Jacket: 4-mil nylon.
- e. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.

2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

Cable Sizes: Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.48	45
8	0.63	60
12	0.75	60
16	0.83	60
24	1.10	80
36	1.21	80
50	1.50	80

3. Manufacturers:
- a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.

H. Type 7, Multiconductor Metal-Clad (UL Type MC) Power Cable:

- 1. Meeting requirements of UL 44 and UL 1569.
- 2. Conductors:
 - a. Class B stranded, coated copper.
 - b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW or EPR.
 - c. Grounding Conductors: Bare, stranded copper.
- 3. Sheath:
 - a. UL listed Type MC.
 - b. Continuous welded, corrugated aluminum sheath.
 - c. Suitable for use as grounding conductor.
- 4. Outer Jacket: PVC per UL 1569.
- 5. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

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6. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	12 or 3x16	3 4	0.79 0.85	50
10 AWG	10 or 3x14	3 4	0.82 0.90	50
8 AWG	10 or 3x14	3 4	0.85 1.00	50
6 AWG	8 or 3x12	3 4	0.99 1.10	50
4 AWG	8 or 3x12	3 4	1.08 1.20	50
2 AWG	6 or 3x10	3 4	1.24 1.45	50
1 AWG	6 or 3x10	3 4	1.40 1.55	50
1/0 KCM	6 or 3x10	3 4	1.52 1.60	50
2/0 AWG	4 or 3x8	3 4	1.67 1.75	50
4/0 AWG	4 or 3x8	3 4	1.93 2.10	60
250 KCM	4 or 3x8	3 4	2.11 2.20	60
350 KCM	3 or 3x8	3 4	2.39 2.50	60
500 KCM	2 or 3x8	3 4	2.80 2.90	75

7. Manufacturers and Products:

- a. Okonite Co.; Type CLX.
- b. Southwire Type MC.
- c. General Cable, CCW Armored Power.

I. Type 8, Multiconductor Adjustable Frequency Drive Power Cable:

1. Conductors:
 - a. Class B, stranded coated copper.
 - b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW-2.
 - c. Grounding Conductors: Insulated stranded copper.
2. Sheath:
 - a. UL 1277 Type TC, 90 degrees C.
 - b. Continuous shield, A1/polyester foil, drain wires, overall copper braid.
3. Outer Jacket: Polyvinyl chloride (PVC) per UL 1569.
4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Minimum Jacket Thickness (Mils)
12 AWG	12	4	0.655	50
10 AWG	10	4	0.769	50
8 AWG	8	4	0.940	50
6 AWG	6	4	1.038	50
4 AWG	4	4	1.180	50
2 AWG	2	4	1.351	50

5. Manufacturers and Products:
 - a. Alpha Wire; Series V.
 - b. Belden; Series 29500.
 - c. LAPP USA; OLFLEX VFD Slim.

J. Type 9, Multiconductor Metal-Clad (UL Type MC) Power Cable for Adjustable Frequency Drive Applications:

1. Meeting requirements of UL 44 and UL 1569.
2. Conductors:
 - a. Class B, stranded coated copper.
 - b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW or Type EPR.
 - c. Grounding Conductors: Bare, stranded copper. Provide three symmetrical grounding conductors.

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3. Sheath:
 - a. UL listed Type MC.
 - b. Continuous welded, corrugated aluminum sheath.
 - c. Suitable for use as grounding conductor.
4. Outer Jacket: PVC per UL 1569.
5. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
6. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	3x16	3	0.79	50
		4	0.85	
10 AWG	3x14	3	0.82	50
		4	0.90	
8 AWG	3x14	3	0.85	50
		4	1.00	
6 AWG	3x12	3	0.99	50
		4	1.10	
4 AWG	3x12	3	1.08	50
		4	1.20	
2 AWG	3x10	3	1.24	50
		4	1.45	
1 AWG	3x10	3	1.40	50
		4	1.55	
1/0 KCM	3x10	3	1.52	50
		4	1.60	
2/0 AWG	3x8	3	1.67	50
		4	1.75	
4/0 AWG	3x8	3	1.93	60
		4	2.10	
250 KCM	3x8	3	2.11	60
		4	2.20	

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
350 KCM	3x8	3	2.39	60
		4	2.50	
500 KCM	3x8	3	2.80	75
		4	2.90	

7. Manufacturer and Product: Okonite Co.; Type CLX MC-HL.

2.03 300-VOLT RATED CABLE

A. General:

1. Type PLTC, meeting requirements of UL 13 and NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 105 degrees C.
5. Passes Vertical Tray Flame Test.
6. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 20, 16 AWG, Twisted, Shielded Pair Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 57.

1. Outer Jacket: 35-mil nominal.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.26-inch nominal OD.
4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil PVC.
 - d. Color Code: Pair conductors black and white.
5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.

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- C. Type 21, 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting requirements of NEMA WC 57.
1. Outer Jacket: 35-mil nominal thickness.
 2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
 3. Dimension: 0.28-inch nominal OD.
 4. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. 20 AWG, seven-strand tinned copper drain wire.
 - c. Insulation: 15-mil PVC.
 - d. Color Code: Triad conductors; black, red, and white.
 5. Manufacturers:
 - a. Okonite Co.
 - b. Alpha Wire Corp.
- D. Type 22, 18 AWG, Multitwisted, Shielded Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 57.
1. Conductors:
 - a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
 - b. Tinned copper drain wires.
 - c. Pair drain wire size AWG 20, group drain wire size AWG 18.
 - d. Insulation: 15-mil PVC.
 - e. Color Code: Pair conductors black and white; white conductor numerically printed for group identification.
 - f. Individual Pair Shield: 1.35-mil aluminum/mylar.
 - g. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

2. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	50
8	0.66	60
12	0.79	60
16	0.91	60
24	1.13	70
36	1.31	70
50	1.55	80

3. Manufacturers:

- a. Okonite Co.
- b. Alpha Wire Corp.
- c. Belden.

E. Type 23, 18 AWG, Multitwisted Pairs with Common Overall Shield
Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 57.

1. Conductors:

- a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
- b. Tinned copper.
- c. Group drain wire size AWG 20, minimum.
- d. Insulation: 15-mil PVC.
- e. Color Code: Pair conductors black and white; white conductor numerically printed for group identification.
- f. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

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2. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.48	50
8	0.63	60
12	0.73	60
16	0.77	60
24	0.96	70
36	1.09	70
50	1.45	50

3. Manufacturers:
- a. Okonite Co.
 - b. Alpha Wire Corp.
 - c. Belden.

2.04 SPECIAL CABLES

- A. Type 30, Unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V:
- 1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-C Category 6 requirements.
 - 2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
 - 3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
 - 4. NFPA 70 Plenum (CMP) rated; comply with flammability plenum requirements of NFPA 70 and NFPA 262.
 - 5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
 - 6. Manufacturer and Product: Belden; 7852A.

2.05 GROUNDING CONDUCTORS

- A. Equipment: Stranded copper with green, Type USE/RHH/RHW-XLPE or THHN/THWN, insulation.
- B. Direct Buried: Bare stranded copper.

2.06 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing:
 - a. 30-mil, elastomer.
 - b. Manufacturers and Products:
 - 1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - 2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices:

1. Sleeve:
 - a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturers and Products:
 - 1) Raychem; Type D-SCE or Type ZH-SCE.
 - 2) Brady, Type 3PS.
2. Heat Bond Marker:
 - a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
 - b. Self-laminating protective shield over text.
 - c. Machine printed black text.
 - d. Manufacturer and Product: 3M Co.; Type SCS-HB.
3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
4. Tie-On Cable Marker Tags:
 - a. Chemical-resistant white tag.
 - b. Size: 1/2-inch by 2 inches.
 - c. Manufacturer and Product: Raychem; Type CM-SCE.
5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

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C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulug.
 - 3) ILSCO.
2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO; ILSCONS.
3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. UL 486C.
 - b. Plated steel, square wire springs.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
4. Self-Insulated, Set Screw Wire Connector:
 - a. Two piece compression type with set screw in brass barrel.
 - b. Insulated by insulator cap screwed over brass barrel.
 - c. Manufacturers:
 - 1) 3M Co.
 - 2) Thomas & Betts.
 - 3) Marrette.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Manufacturers and Products:
 - 1) Thomas & Betts; Color-Keyed.
 - 2) Burndy; Hydent.
 - 3) ILSCO.

4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Single wall for insulation and strain relief.
3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
4. Manufacturers and Products:
 - a. Thomas & Betts; SHRINK-KON.
 - b. Raychem; RNF-100 and ES-2000.

2.07 PULLING COMPOUND

- A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Approved for intended use by cable manufacturer.
- D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.
- E. Manufacturers:
 1. Ideal Co.
 2. Polywater, Inc.
 3. Cable Grip Co.

2.08 WARNING TAPE

- A. As specified in Section 26 05 33, Raceway and Boxes.

2.09 SOURCE QUALITY CONTROL

- A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

PART 3 EXECUTION

3.01 GENERAL

- A. Conductor installation shall be in accordance with manufacturer's recommendations.
- B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
- C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- D. Terminate conductors and cables, unless otherwise indicated.
- E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors and aluminum conductors.
- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.
- G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches on center.
- H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4-inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

- A. Conductors 600 Volts and Below:
 - 1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
 - 2. 8 AWG and Smaller: Provide colored conductors.

3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts, Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts, Three-Phase, Four-Wire, Delta, Center Tap, Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts, Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
Note: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

- A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.
- C. Circuits Not Appearing in Circuit Schedules:
 - 1. Assign circuit name based on device or equipment at load end of circuit.
 - 2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

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D. Method:

1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables and Conductors 2 AWG and Larger:
 - a. Identify with marker plates or tie-on cable marker tags.
 - b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.
8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:
 - a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - b. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

- E. Splices and Terminations:
 - 1. Insulate uninsulated connections.
 - 2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
 - 3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
 - 4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.
- F. Cap spare conductors with UL listed end caps.
- G. Cabinets, Panels, and Motor Control Centers:
 - 1. Remove surplus wire, bridle and secure.
 - 2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.
- H. Control and Instrumentation Wiring:
 - 1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
 - 2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
 - 3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
 - 4. Cable Protection:
 - a. Under Infinite Access Floors: May install without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2-inch in diameter.
 - c. Maintain integrity of shielding of instrumentation cables.
 - d. Ensure grounds do not occur because of damage to jacket over shield.
- I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

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3.05 CONDUCTOR ARC AND FIREPROOFING

- A. Wrap conductors of same circuit entering from separate conduit together as single cable.
- B. Follow tape manufacturer's installation instructions.
- C. Secure tape at intervals of 5 feet with bands of tapebinder. Each band to consist of a minimum of two wraps directly over each other.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).
3. UL.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
 - a. Product data for the following:
 - 1) Ground rod.
 - 2) Grounding wells.
 - 3) Exothermic weld connectors.
 - 4) Mechanical connectors.
 - 5) Compression connectors.
 - 6) Specialty tools.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by UL:
 - a. Confirm conformance with UL standards.
 - b. Supply with an applied UL listing mark.

PART 2 PRODUCTS

2.01 GROUND CONDUCTORS

- A. As specified in Section 26 05 05, Conductors.

2.02 CONNECTORS

- A. Exothermic Weld Type:

1. Outdoor Weld: Suitable for exposure to elements or direct burial.
2. Indoor Weld: Use low-smoke, low-emission process.
3. Manufacturers and Product:
 - a. NVent ERICO Products, Inc.; Cadweld and Cadweld Exolon.
 - b. ThermOweld.

- B. Compression Type:

1. Compress-deforming irreversible type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels prefilled with oxide-inhibiting and anti-seizing compound and sealed.
5. Manufacturers and Products:
 - a. Burndy Corp.; Hyground Compression.
 - b. Thomas and Betts Co.; EZGround Compression.
 - c. NVent ILSCO.

- C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.

1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. O-Z Gedney.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide Grounding in compliance with NFPA 70 and IEEE C2.
- B. Bond electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.
- C. Bond each separately derived system neutral with common grounding electrode conductor to grounding electrode system.
- D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.
- E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- F. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.
- G. Shielded Instrumentation Cables:
 - 1. Ground shield to ground bus at power supply for analog signal.
 - 2. Expose shield minimum 1-inch at termination to field instrument and apply heat shrink tube.
 - 3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Connect ground conductors to raceway grounding bushings.
- D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.
- E. Connect enclosure of equipment containing ground bus to that bus.
- F. Bolt connections to equipment ground bus.

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- G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.
- I. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.03 MOTOR GROUNDING

- A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.
- B. Nonmetallic Raceways and Flexible Tubing: Install an equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Motors Less Than 10 hp: Use furnished ground lug in motor connection box. If none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.
- D. Motors 10 hp and Above: Use furnished ground lug in motor connection box. If none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.
- E. Circuits 20 Amps or Above: Tap motor frame or equipment housing. Install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 CONNECTIONS

- A. General:
 - 1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
 - 2. Belowgrade Connections: Install exothermic weld or compression type connectors.
 - 3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
 - 4. Notify Engineer prior to backfilling ground connections.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.

D. Mechanical Type:

1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
2. Install in accordance with connector manufacturer's recommendations.
3. Do not conceal mechanical connections.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges.
 2. ASTM International (ASTM):
 - a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
 - b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - e. D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
 3. National Electrical Contractor's Association, Inc. (NECA): Installation standards.
 4. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C80.1, Electrical Rigid Steel Conduit (ERSC).
 - c. C80.3, Steel Electrical Metallic Tubing (EMT).
 - d. C80.5, Electrical Rigid Aluminum Conduit (ERAC).
 - e. C80.6, Electrical Intermediate Metal Conduit (EIMC).
 - f. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - g. TC 2, Electrical Polyvinyl Chloride (PVC) Conduit.
 - h. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
 - i. TC 6, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation.
 - j. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - k. VE 1, Metallic Cable Tray Systems.

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5. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
6. Telecommunications Industry Association (TIA): 569B, Commercial Building Standard for Telecommunications Pathways and Spaces.
7. UL:
 - a. 1, Standard for Safety for Flexible Metal Conduit.
 - b. 5, Standard for Safety for Surface Metal Raceways and Fittings.
 - c. 6, Standard for Safety for Electrical Rigid Metal Conduit – Steel.
 - d. 6A, Standard for Safety for Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless.
 - e. 360, Standard for Safety for Liquid-Tight Flexible Steel Conduit.
 - f. 514B, Standard for Safety for Conduit, Tubing, and Cable Fittings.
 - g. 651, Standard for Safety for Schedule 40 and Schedule 80 Rigid PVC Conduit and Fittings.
 - h. 651A, Standard for Safety for Type EB and Type A Rigid PVC Conduit and HDPE Conduit.
 - i. 797, Standard for Safety for Electrical Metallic Tubing – Steel.
 - j. 870, Standard for Safety for Wireways, Auxiliary Gutters, and Associated Fittings.
 - k. 1242, Standard for Safety for Electrical Intermediate Metal Conduit – Steel.
 - l. 1660, Standard for Safety for Liquid-Tight Flexible Nonmetallic Conduit.
 - m. 1684, Standard for Safety for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
 - n. 2024, Standard for Safety for Optical Fiber and Communication Cable Raceway.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer's Literature:
 - a. Rigid galvanized steel conduit.
 - b. PVC-coated rigid galvanized steel.
 - c. Conduit fittings.
 - d. Wireways.
 - e. Device boxes for use in hazardous areas.
 - f. Junction and pull boxes used at or below grade.
 - g. Large junction and pull boxes.
 - h. Terminal junction boxes.
2. Equipment and machinery proposed for bending metal conduit.
3. Method for bending PVC conduit less than 30 degrees.

4. Seismic anchorage and bracing drawings and cut sheets, as required by the structural engineer.
5. Conduit Layout:
 - a. Provide Drawings for conduit installations.
 - b. Provide plan and section showing arrangement and location of conduit and duct bank required for:
 - 1) Low and medium voltage feeder and branch circuits.
 - 2) Instrumentation and control systems.
 - 3) Communications systems.
 - 4) Empty conduit for future use.
 - c. Electronic CAD; scale not greater than 1-inch equals 20 feet.

B. Informational Submittals:

1. Seismic anchorage and bracing calculations as required by the structural engineer.
2. Component and attachment testing seismic certificate of compliance as required by AHJ and Owner.
3. Manufacturer's certification of training for PVC-coated rigid galvanized steel conduit installer.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

- B. PVC-Coated, Rigid Galvanized Steel Conduit Installer: Certified by conduit manufacturer as having received minimum 2 hours of training on installation procedures.

PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of NEMA C80.1 and UL 6.
2. Material: Hot-dip galvanized with chromated protective layer.

B. PVC-Coated Rigid Galvanized Steel Conduit:

1. Meet requirements of NEMA RN 1 and ETL.
2. Material:
 - a. Meet requirements of NEMA C80.1 and UL 6.
 - b. Exterior Finish: PVC coating, 40-mil nominal thickness; bond to metal shall have tensile strength greater than PVC.
 - c. Interior finish: Urethane coating, 2-mil nominal thickness.
3. Threads: Hot-dipped galvanized and factory coated with urethane.
4. Bendable without damage to interior or exterior coating.

2.02 FITTINGS

A. Rigid Galvanized Steel Conduit:

1. General:
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
 - a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
 - b. Manufacturers and Products:
 - 1) Appleton; Series BU-I.
 - 2) O-Z/Gedney; Type HB.
3. Grounding Bushing:
 - a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
 - b. Manufacturers and Products:
 - 1) Appleton; Series GIB.
 - 2) O-Z/Gedney; Type HBLG.
4. Conduit Hub:
 - a. Material: Malleable iron with insulated throat with bonding screw.
 - b. UL listed for use in wet locations.

- c. Manufacturers and Products:
 - 1) Appleton, Series HUB-B.
 - 2) O-Z/Gedney; Series CH.
 - 3) Meyers; ST Series.
- 5. Conduit Bodies:
 - a. Sized as required by NFPA 70.
 - b. Manufacturers and Products (For Normal Conditions):
 - 1) Appleton; Form 35 threaded unilets.
 - 2) Crouse-Hinds; Form 7 or Form 8 threaded condulets.
 - 3) Killark; Series O electrolets.
 - 4) Thomas & Betts; Form 7 or Form 8.
 - c. Manufacturers (For Hazardous Locations):
 - 1) Appleton.
 - 2) Crouse-Hinds.
 - 3) Killark.
- 6. Couplings: As supplied by conduit manufacturer.
- 7. Unions:
 - a. Concrete tight, hot-dip galvanized malleable iron.
 - b. Manufacturers and Products:
 - 1) Appleton; Series SCC bolt-on coupling or Series EC three-piece union.
 - 2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.
- 8. Conduit Sealing Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYF, Type EYM, or Type ESU.
 - 2) Crouse-Hinds; Type EYS or Type EZS.
 - 3) Killark; Type EY or Type EYS.
- 9. Drain Seal:
 - a. Manufacturers and Products:
 - 1) Appleton; Type EYD.
 - 2) Crouse-Hinds; Type EYD or Type EZD.
- 10. Drain/Breather Fitting:
 - a. Manufacturers and Products:
 - 1) Appleton; Type ECDB.
 - 2) Crouse-Hinds; Type ECD.
- 11. Expansion Fitting:
 - a. Manufacturers and Products:
 - 1) Deflection/Expansion Movement:
 - a) Appleton; Type DF.
 - b) Crouse-Hinds; Type XD.

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- 2) Expansion Movement Only:
 - a) Appleton; Type XJ.
 - b) Crouse-Hinds; Type XJ.
 - c) Thomas & Betts; XJG-TP.
12. Cable Sealing Fitting:
 - a. To form watertight nonslip cord or cable connection to conduit.
 - b. For Conductors with OD of 1/2-inch or Less: Neoprene bushing at connector entry.
 - c. Manufacturers and Products:
 - 1) Appleton; CG-S.
 - 2) Crouse-Hinds; CGBS.
- B. PVC-Coated Rigid Galvanized Steel Conduit:
 1. Meet requirements of UL 514B.
 2. Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
 3. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
 4. Finish: 40-mil PVC exterior, 2-mil urethane interior.
 5. Overlapping pressure-sealing sleeves.
 6. Conduit Hangers, Attachments, and Accessories: PVC-coated.
 7. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.
 8. Expansion Fitting:
 - a. Manufacturer and Product: Ocal; OCAL-BLUE XJG.
- C. Watertight Entrance Seal Device:
 1. New Construction:
 - a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Type FSK or Type WSK, as required.
 2. Cored-Hole Application:
 - a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
 - b. Manufacturer and Product: O-Z/Gedney; Series CSM.

2.03 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc-plated or cadmium-plated.
- B. Cast Aluminum:
 - 1. Material:
 - a. Box: Cast, copper-free aluminum.
 - b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
 - 2. Hubs: Threaded.
 - 3. Lugs: Cast mounting.
 - 4. Manufacturers and Products, Nonhazardous Locations:
 - a. Crouse-Hinds; Type FS-SA or Type FD-SA.
 - b. Appleton; Type FS or Type FD.
 - c. Killark.
 - 5. Manufacturers and Products, Hazardous Locations:
 - a. Crouse-Hinds; Type GUA-SA.
 - b. Appleton; Type GR.
- C. PVC-Coated Cast Metal:
 - 1. Type: One-piece.
 - 2. Material: Malleable iron, cast ferrous metal, or cast aluminum.
 - 3. Coating:
 - a. Exterior Surfaces: 40-mil PVC.
 - b. Interior Surfaces: 2-mil urethane.
 - 4. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.
- D. Nonmetallic:
 - 1. Box: PVC.
 - 2. Cover: PVC, weatherproof, with stainless steel screws.
 - 3. Manufacturer and Product: Carlon; Type FS or Type FD, with Type E98 or Type E96 covers.

2.04 JUNCTION AND PULL BOXES

- A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.
- B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

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C. Large Sheet Steel Box:

1. NEMA 250, Type 1.
2. Box: Code-gauge, galvanized steel.
3. Cover: Full access, screw type.
4. Machine Screws: Corrosion-resistant.

D. Large Nonmetallic Box:

1. NEMA 250 Type 4X.
2. Box: High-impact, fiberglass-reinforced polyester or engineered thermoplastic, with stability to high heat.
3. Cover: Hinged with clamps.
4. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
5. Conduit hubs and mounting lugs.
6. Manufacturers and Products:
 - a. Crouse-Hinds; Type NJB.
 - b. Carlon; Series N, C, or H.
 - c. Robroy Industries.

2.05 TERMINAL JUNCTION BOX

- A. Cover: Hinged, unless otherwise shown.
- B. Interior Finish: Paint with white enamel or lacquer.
- C. Terminal Blocks:
 1. Separate connection point for each conductor entering or leaving box.
 2. Spare Terminal Points: 25 percent, minimum.

2.06 SURFACE METAL RACEWAY

- A. General:
 1. Meet requirements of UL 5.
 2. Material: Two-piece, code-gauge steel.
 3. Finish: Factory applied rust inhibiting primer and gray semi-gloss finish suitable for field painting.
 4. Configuration: Single, 1-17/32-inch by 2-3/4-inch section, unless otherwise indicated.

- B. Fittings and Accessories:
 - 1. Wire clips at 30 inches on center.
 - 2. Couplings, cover clips, supporting clips, ground clamps, and elbows as required; to comply with manufacturer's recommendations.
- C. Outlets:
 - 1. Provide bracket or device covers as required to support wiring devices indicated.
 - 2. Wiring Devices and Device Plates: In accordance with Section 26 27 26, Wiring Devices.
 - 3. Manufacturers:
 - a. The Wiremold Co.
 - b. Walker.

2.07 METAL WIREWAYS

- A. Meet requirements of UL 870.
- B. Type: Steel-enclosed, lay-in type.
- C. Cover: Removable, screw type.
- D. Rating: Indoor.
- E. Finish: Rust inhibiting phosphatizing primer and gray baked enamel.
- F. Hardware: Plated to prevent corrosion; screws installed toward the inside protected by spring nuts or otherwise guarded to prevent wire insulation damage.
- G. Knockouts: Without knockouts, unless otherwise indicated.
- H. Manufacturers:
 - 1. Circle AW.
 - 2. Hoffman.
 - 3. Square D.

2.08 NONMETALLIC WIREWAY

- A. Rating: Outdoor, corrosion resistant, raintight, NEMA Type 12 and Type 3R.
- B. Type: Fiberglass-enclosed, with removable cover.

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- C. Captivated, corrosion-resistant cover screws.
- D. Oil-resistant gaskets.
- E. Meet UL cold impact test to minus 35 degrees C.
- F. Manufacturer: Hoffman.

2.09 ACCESSORIES

A. Identification Devices:

1. Raceway Tags:

- a. Material: Permanent, nonferrous metal.
- b. Shape: Round.
- c. Raceway Designation: Pressure stamped, embossed, or engraved.
- d. Tags relying on adhesives or taped-on markers not permitted.

B. Raceway Coating: Clean and paint in accordance with Section 09 90 00, Painting and Coating.

C. Heat Shrinkable Tubing:

- 1. Material: Heat-shrinkable, cross-linked polyolefin.
- 2. Semi-flexible with meltable adhesive inner liner.
- 3. Color: Black.
- 4. Manufacturers:
 - a. Raychem.
 - b. 3M.

D. Wraparound Duct Band:

- 1. Material: Heat-shrinkable, cross-linked polyolefin, precoated with hot-melt adhesive.
- 2. Width: 50 mm minimum.
- 3. Manufacturer and Product: Raychem; Type TWDB.

PART 3 EXECUTION

3.01 GENERAL

- A. Conduit and tubing sizes shown are based on use of copper conductors. Reference Section 26 05 05, Conductors, concerning conduit sizing for aluminum conductors.
- B. Comply with NECA Installation Standards.
- C. Crushed or deformed raceways not permitted.
- D. Maintain raceway entirely free of obstructions and moisture.
- E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- F. Aluminum Conduit: Do not install in direct contact with concrete. Install in PVC sleeve or cored hole through concrete walls and slabs.
- G. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- H. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- I. Group raceways installed in same area.
- J. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.
- K. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- L. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- M. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.
- N. Install watertight fittings in outdoor, underground, or wet locations.
- O. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.

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- P. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- Q. Do not install raceways in concrete equipment pads, foundations, or beams without Engineer approval.
- R. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- S. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
- T. Install conduits for fiber optic cables, telephone cables, and Category 6 data cables in strict conformance with the requirements of TIA 569B.

3.02 REUSE OF EXISTING CONDUITS

- A. Where the Drawings indicate existing conduits may be reused, they may be reused only where they meet the following criteria.
 - 1. Conduit is in useable condition with no deformation, corrosion, or damage to exterior surface.
 - 2. Conduit is sized per the NEC.
 - 3. Conduit is of the type specified in Contract Documents.
 - 4. Conduit is supported as specified in Contract Documents.
- B. Conduit shall be reamed with wire brush, then with a mandrel approximately 1/4-inch smaller than raceway inside diameter then cleaned prior to pulling new conductors.

3.03 INSTALLATION IN CAST-IN-PLACE STRUCTURAL CONCRETE

- A. Minimum Cover: 2 inches, including fittings.
- B. Conduit placement shall not require changes in reinforcing steel location or configuration.
- C. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.
- D. Conduit larger than 1-inch shall not be embedded in concrete slabs, walls, foundations, columns, or beams unless approved by the Engineer.

- E. Slabs and Walls (Requires Engineer Approval):
1. Trade size of conduit not to exceed one-fourth of slab or wall thickness.
 2. Install within middle two-fourths of slab or wall.
 3. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.
 4. Separate conduit 2-inch and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
 5. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1-inch.
 6. Separate conduit by a minimum six times the outside dimension of expansion/deflection fittings at expansion joints.
 7. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.
- F. Columns and Beams (Requires Engineer Approval):
1. Trade size of conduit not to exceed one-fourth of beam thickness.
 2. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.

3.04 CONDUIT APPLICATION

- A. Diameter: Minimum 1/2-inch.
- B. Interior, Exposed:
1. Rigid galvanized steel.
 2. PVC-coated rigid galvanized steel.
- C. Interior, Concealed (Not Embedded in Concrete): Rigid galvanized steel.
- D. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors: Rigid galvanized steel.
- E. Under Slabs-On-Grade: Rigid galvanized steel.
- F. Transition from Underground or Concrete Embedded to Exposed: Rigid galvanized steel conduit.
- G. Under Equipment Mounting Pads: Rigid galvanized steel conduit.

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3.05 FLEXIBLE CONNECTIONS

- A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other locations approved by the Engineer where flexible connection is required to minimize vibration:
 - 1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
 - 2. Conduit Size Over 4 Inches: Nonflexible.
 - 3. Wet or Corrosive Areas: Flexible, nonmetallic flexible metal liquid-tight.
 - 4. Dry Areas: Flexible, metallic liquid-tight.
- B. Flexible Conduit Length: 18 inches minimum, 60 inches maximum; sufficient to allow movement or adjustment of equipment.

3.06 PENETRATIONS

- A. Make at right angles, unless otherwise shown.
- B. Notching or penetration of structural members, including footings and beams, not permitted.
- C. Apply heat shrinkable tubing to metallic conduit protruding through concrete floor slabs to a point 2 inches above and 2 inches below concrete surface.
- D. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.
- E. Entering Structures:
 - 1. General: Seal raceway at first box or outlet with oakum or expandable plastic compound to prevent entrance of gases or liquids from one area to another.
 - 2. Concrete Roof or Membrane Waterproofed Wall or Floor:
 - a. Provide a watertight seal.
 - b. Without Concrete Encasement: Install watertight entrance seal device on each side.
 - c. With Concrete Encasement: Install watertight entrance seal device on accessible side.
 - d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
 - e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.

3. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
4. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
 - a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
 - b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.

3.07 SUPPORT

- A. Support from structural members only, at intervals not exceeding NFPA 70 requirements. Do not exceed 8 feet in any application. Do not support from piping, pipe supports, or other raceways.
- B. Multiple Adjacent Raceways: Provide ceiling trapeze.
- C. Application/Type of Conduit Strap:
 1. Aluminum Conduit: Aluminum or stainless steel.
 2. Rigid Steel or EMT Conduit: Zinc-coated steel, pregalvanized steel or malleable iron.
 3. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
 4. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
- D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
 1. Wood: Wood screws.
 2. Hollow Masonry Units: Toggle bolts.
 3. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
 4. Steelwork: Machine screws.
 5. Location/Type of Hardware:
 - a. Dry, Noncorrosive Areas: Galvanized.
 - b. Wet, Noncorrosive Areas: Stainless steel.
 - c. Corrosive Areas: Stainless steel.
- E. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.
- F. Support aluminum conduit on concrete surfaces with stainless steel or nonmetallic spacers, or aluminum or nonmetallic framing channel.

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3.08 BENDS

- A. Install concealed raceways with a minimum of bends in the shortest practical distance.
- B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
- C. Install with symmetrical bends or cast metal fittings.
- D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
- E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
- F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.
- G. PVC Conduit:
 - 1. Bends 30 Degrees and Larger: Provide factory-made elbows.
 - 2. Use manufacturer's recommended method for forming smaller bends.
- H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.09 PVC-COATED RIGID STEEL CONDUIT

- A. Install in accordance with manufacturer's instructions.
- B. Tools and equipment used in cutting, bending, threading and installation of PVC-coated rigid conduit shall be designed to limit damage to PVC coating.
- C. Provide PVC boot to cover exposed threading.

3.10 WIREWAYS

- A. Install in accordance with manufacturer's instructions.
- B. Locate with cover on accessible vertical face of wireway, unless otherwise shown.

C. Applications:

1. Metal wireway in indoor dry locations.
2. Nonmetallic wireway in indoor wet, outdoor, and corrosive locations.

3.11 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Install manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Nonmetallic, Cabinets, and Enclosures:

1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
2. Metallic Conduit: Provide ground terminal for connection to maintain continuity of ground system.

C. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:

- a. Install insulated bushing on ends of conduit where grounding is not required.
- b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
- c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
- d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
- e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.

2. Rigid Galvanized Conduit:

- a. Provide one lock nut each on inside and outside of enclosure.
- b. Install grounding bushing at source enclosure.
- c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.

3. Electric Metallic Tubing: Provide gland compression, insulated connectors.

4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.

5. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.

6. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.

7. PVC Schedule 40 Conduit: Provide PVC terminal adapter with lock nut, except where threaded hubs required above.

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- D. Motor Control Center, Switchboard Free-Standing Enclosures:
 - 1. Terminate metal conduit entering bottom with grounding bushing; provide grounding jumper extending to equipment ground bus or grounding pad.
 - 2. Terminate PVC conduit entering bottom with bell end fittings.

3.12 UNDER SLAB RACEWAYS

- A. Make routing changes as necessary to avoid obstructions or conflicts.
- B. Support raceways so as to prevent bending or displacement during backfilling or concrete placement.
- C. Install raceways with no part embedded within slab and with no interference with slab on grade construction.
- D. Raceway spacing, in a single layer or multiple layers:
 - 1. 3 inches clear between adjacent 2-inch or larger raceway.
 - 2. 2 inches clear between adjacent 1-1/2-inch or smaller raceway.
- E. Multiple Layers of Raceways: Install under slab on grade in trench below backfill zone, as specified by the civil and structural engineers.
- F. Individual Raceways and Single Layer Multiple Raceways: Install at lowest elevation of backfill zone with spacing as specified herein. Where conduits cross at perpendicular orientation, installation of conduits shall not interfere with placement of under slab fill that meets compaction and void limitations of earthwork specifications.
- G. Under slab raceways that emerge from below slab to top of slab as exposed, shall be located to avoid conflicts with structural slab rebar. Coordinate raceway stub ups with location of structural rebar.
- H. Fittings:
 - 1. Union type fittings are not permitted.
 - 2. Provide expansion/deflection fittings in raceway runs that exit building or structure below slab. Locate fittings 18 inches, maximum, beyond exterior wall. Raceway type between building exterior wall to fitting shall be PVC-coated rigid steel.
 - 3. Couplings: In multiple raceway runs, stagger so couplings in adjacent runs are not in same traverse line.

3.13 OUTLET AND DEVICE BOXES

A. General:

1. Install plumb and level.
2. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
3. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.
4. Install galvanized mounting hardware in industrial areas.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
 - a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
2. Ceiling Outlet: Minimum 4-inch octagonal device box, unless otherwise required for installed fixture.
3. Switch and Receptacle: Minimum 2-inch by 4-inch device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by the Engineer.

D. Mounting Height:

1. General:
 - a. Dimensions given to centerline of box.
 - b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference.
 - c. Do not straddle CMU block or other construction joints.
2. Light Switch:
 - a. 48 inches above floor.
 - b. When located next to door, install on lock side of door.
3. Thermostat: 54 inches above floor.
4. Telephone Outlet:
 - a. 15 inches above floor.
 - b. 6 inches above counter tops.
 - c. Wall Mounted: 52 inches above floor.

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5. Convenience Receptacle:
 - a. General Interior Areas: 15 inches above floor.
 - b. General Interior Areas (Counter Tops): Install device plate bottom or side flush with top of backsplash, or 6 inches above counter tops without backsplash.
 - c. Industrial Areas, Workshops: 48 inches above floor.
 6. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on the Drawings.
- E. Flush Mounted:
1. Install with concealed conduit.
 2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
 3. Holes in surrounding surface shall be no larger than required to receive box.
- F. Supports:
1. Support boxes independently of conduit by attachment to building structure or structural member.
 2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
 3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
 4. Provide plaster rings where necessary.
 5. Boxes embedded in concrete or masonry need not be additionally supported.
- G. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.
- H. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

3.14 JUNCTION AND PULL BOXES

A. General:

1. Install plumb and level.
2. Installed boxes shall be accessible.
3. Do not install on finished surfaces.
4. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
5. Use conduit bodies as junction and pull boxes where no splices are required and allowed by applicable codes.
6. Install pull boxes where necessary in raceway system to facilitate conductor installation.
7. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
8. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

B. Flush Mounted:

1. Install with concealed conduit.
2. Holes in surrounding surface shall be no larger than required to receive box.
3. Make edges of boxes flush with final surface.

C. Mounting Hardware:

1. Noncorrosive Dry Areas: Galvanized.
2. Noncorrosive Wet Areas: Stainless steel.
3. Corrosive Areas: Stainless steel.

D. Supports:

1. Support boxes independently of conduit by attachment to building structure or structural member.
2. Install bar hangers in frame construction or fasten boxes directly as follows:
 - a. Wood: Wood screws.
 - b. Concrete or Brick: Bolts and expansion shields.
 - c. Hollow Masonry Units: Toggle bolts.
 - d. Steelwork: Machine screws.
3. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.
4. Boxes embedded in concrete or masonry need not be additionally supported.

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- E. At or Below Grade:
 - 1. Install boxes for below grade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.
 - 2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
 - 3. Obtain the Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
 - 4. Use boxes and covers suitable to support anticipated weights.
- F. Install Drain/breather fittings in NEMA 250 Type 4 and Type 4X enclosures.

3.15 IDENTIFICATION DEVICES

- A. Raceway Tags:
 - 1. Identify origin and destination.
 - 2. For exposed raceways, install tags at each terminus, near midpoint, and at minimum intervals of every 50 feet, whether in ceiling space or surface mounted.
 - 3. Install tags at each terminus for concealed raceways.
 - 4. Provide noncorrosive wire for attachment.

3.16 PROTECTION OF INSTALLED WORK

- A. Protect products from effects of moisture, corrosion, and physical damage during construction.
- B. Provide and maintain manufactured watertight and dust-tight seals over conduit openings during construction.
- C. Touch up painted conduit threads after assembly to cover nicks or scars.
- D. Touch up coating damage to PVC-coated conduit with patching compound approved by manufacturer. Compound shall be kept refrigerated according to manufacturers' instructions until time of use.

END OF SECTION

SECTION 26 05 70
ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American National Standards Institute (ANSI).
 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - d. 1584, Guide for Performing Arc Flash Hazard Calculations.
 3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

1.02 SUBMITTALS

- A. Action Submittals:
1. Short circuit study.
 2. Protective Device Coordination Study: Submit within 90 days after approval of short circuit study.
 3. Arc Flash Study: Submit initial study with protective Device Coordination Study. Submit final study prior to equipment energization.
 4. Arc flash warning labels; submit sample with initial study.
 5. Electronic files of final studies including all engineering software input files, output reports, and libraries.

1.03 QUALITY ASSURANCE

- A. Short circuit and protective device coordination and arc flash studies shall be prepared by a professional electrical engineer registered in the State of Utah.

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1.04 SEQUENCING AND SCHEDULING

- A. Initial complete short circuit study shall be submitted and reviewed before the Engineer will review Shop Drawings for switchboard, adjustable frequency drive and associated power distribution equipment.
- B. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study.
- C. Initial complete arc flash study shall be submitted and accepted prior to energization of the electrical equipment.
- D. Revised short circuit, protective device coordination, and arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.
- E. Final short circuit, protective device coordination, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.
- F. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to Project Substantial Completion.

1.05 GENERAL STUDY REQUIREMENTS

- A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on the Drawings.
- B. Perform studies using one of the following electrical engineering software packages:
 - 1. SKM Power Tools for Windows.
 - 2. ETAP.
- C. Perform complete fault calculations for each existing source combination.
 - 1. Source combination may include present and future power company supply circuits, large motors, or generators.
- D. Utilize proposed and existing load data for study obtained from field investigation of system configuration, wiring information, and equipment.

- E. Existing System and Equipment:
 - 1. Extent of existing system to be included in study is limited to system elements that affect new system and equipment.
 - 2. Include fault contribution of existing motors and equipment in study.
 - 3. Include impedance elements that affect new system and equipment.
 - 4. Include protective devices in series with new equipment.
- F. Device coordination time-current curves for low voltage distribution system; include individual protective device time-current characteristics.

1.06 SHORT CIRCUIT STUDY

- A. General:
 - 1. Prepare in accordance with IEEE 399.
 - 2. Use cable impedances based on copper conductors, except where aluminum conductors are specified or shown.
 - 3. Use bus impedances based on copper bus bars, except where aluminum bus bars are specified or shown.
 - 4. Use cable and bus resistances calculated at 25 degrees C.
 - 5. Use medium-voltage cable reactances based on use of typical dimensions of shielded cables with 133 percent insulation levels.
 - 6. Use 600-volt cable reactances based on use of typical dimensions of THHN/THWN and XHHW conductors.
 - 7. Use transformer impedances 92.5 percent of “nominal” impedance based on tolerances specified in IEEE C57.12.00.
- B. Provide:
 - 1. Calculation methods and assumptions.
 - 2. Typical calculation.
 - 3. Tabulations of calculated quantities.
 - 4. Results, conclusions, and recommendations.
 - 5. Selected base per unit quantities.
 - 6. One-line diagrams.
 - 7. Source impedance data, including electric utility system and motor fault contribution characteristics.
 - 8. Impedance diagrams.
 - 9. Zero-sequence impedance diagrams.

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- C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:
 - 1. Electric utility's supply termination point.
 - 2. Main switchboard.
 - 3. Branch circuit panelboards.
- D. Provide bolted line-to-ground fault current study for areas as defined for three-phase bolted fault short circuit study.
- E. Provide bolted line-to-line fault current study for areas as defined for three-phase bolted fault short circuit study.
- F. Verify:
 - 1. Equipment and protective devices are applied within their ratings.
 - 2. Adequacy of switchboard bus bars to withstand short circuit stresses.
 - 3. Adequacy of transformer windings to withstand short circuit stresses.
 - 4. Cable and busway sizes for ability to withstand short circuit heating, in addition to normal load currents.
- G. Tabulations:
 - 1. General Data:
 - a. Short circuit reactances of rotating machines.
 - b. Cable and conduit material data.
 - c. Bus data.
 - d. Transformer data.
 - e. Circuit resistance and reactance values.
 - 2. Short Circuit Data:
 - a. Fault impedances.
 - b. X to R ratios.
 - c. Asymmetry factors.
 - d. Motor contributions.
 - e. Short circuit kVA.
 - f. Symmetrical and asymmetrical fault currents.
 - 3. Equipment Evaluation:
 - a. Equipment bus bracing, equipment short circuit rating, transformer, cable, busway.
 - b. Maximum fault current available.
- H. Written Summary:
 - 1. Scope of studies performed.
 - 2. Explanation of bus and branch numbering system.

3. Prevailing conditions.
4. Selected equipment deficiencies.
5. Results of short circuit study.
6. Comments or suggestions.

- I. Suggest changes and additions to equipment rating and/or characteristics.
- J. Notify the Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.
- K. Revise data for “as-installed” condition.

1.07 PROTECTIVE DEVICE COORDINATION STUDY

A. General:

1. Prepare in accordance with IEEE 242.
2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
 - a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
 - b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four to six.
 - c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
 - d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
 - e. Apply motor protection methods that comply with NFPA 70.

B. Plot Characteristics on Curve Sheets:

1. Electric utility’s relays.
2. Electric utility’s fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
3. Medium-voltage equipment relays.
4. Medium-voltage and low-voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands.
5. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
6. Pertinent transformer full-load currents at 100 percent.
7. Transformer magnetizing inrush currents.

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8. Transformer damage curves; appropriate for system operation and location.
 9. ANSI transformer withstand parameters.
 10. Significant symmetrical and asymmetrical fault currents.
 11. Motor overload relay settings for motors greater than 40 hp.
 12. Ground fault protective device settings.
 13. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.
- C. Primary Protective Device Settings for Delta-Wye Connected Transformer:
1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
 2. Secondary Line-to-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.
- D. Separate medium voltage relay characteristics curves from curves for other devices by at least 0.4-second time margin.
- E. Tabulate Recommended Protective Device Settings:
1. Relays:
 - a. Current tap.
 - b. Time dial.
 - c. Instantaneous pickup.
 - d. Electronic settings data file.
 2. Circuit Breakers:
 - a. Adjustable pickups.
 - b. Adjustable time-current characteristics.
 - c. Adjustable time delays.
 - d. Adjustable instantaneous pickups.
 - e. I²t In/Out.
 - f. Zone interlocking.
 - g. Electronic settings data file.
- F. Written Summary:
1. Scope of studies performed.
 2. Summary of protective device coordination methodology.
 3. Prevailing conditions.
 4. Selected equipment deficiencies.
 5. Results of coordination study.

6. Appendix of complete relay and circuit breaker electronic setting files, submit electronic data files from manufacturer's software.
7. Comments or suggestions.

1.08 ARC FLASH STUDY

- A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted.
- B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.
- C. Base Calculation:
 1. For each major part of electrical power system, determine the following:
 - a. Flash hazard protection boundary.
 - b. Limited approach boundary.
 - c. Restricted approach boundary.
 - d. Incident energy level.
 - e. Glove class required.
- D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.
 1. Bus name.
 2. Bus voltage.
- E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:
 1. Bus name.
 2. Upstream protective device name, type, and settings.
 3. Bus line-to-line voltage.
- F. Produce arc flash evaluation summary sheet listing the following additional items:
 1. Bus name.
 2. Upstream protective device name, type, settings.
 3. Bus line-to-line voltage.
 4. Bus bolted fault.
 5. Protective device bolted fault current.
 6. Arcing fault current.
 7. Protective device trip/delay time.
 8. Breaker opening time.

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9. Solidly grounded column.
 10. Equipment type.
 11. Gap.
 12. Arc flash boundary.
 13. Working distance.
 14. Incident energy.
- G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm². Propose approaches to reduce energy levels.
- H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:
1. Equipment manufacturer's information used to prepare study.
 2. Assumptions made during study.
 3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
 4. Arc flash evaluations summary spreadsheet.
 5. Bus detail sheets.
 6. Arc flash warning labels printed in color on thermally bonded adhesive backed UV and weather-resistant labels.

PART 2 PRODUCTS

2.01 ARC FLASH WARNING LABELS

- A. Arc flash warning labels printed in color on thermally bonded adhesive backed, UV- and weather-resistant labels. An example label is located following end of section in Figure 1.

PART 3 EXECUTION

3.01 GENERAL

- A. Adjust relay and protective device settings according to values established by coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify the Engineer in writing of required major equipment modifications.

- D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.
- E. Provide arc flash warning labels on equipment as specified in this section.

3.02 SUPPLEMENT

- A. The supplement listed below, following “End of Section,” is a part of this specification:
 - 1. Figure 1: Example Arc Flash Label.

END OF SECTION

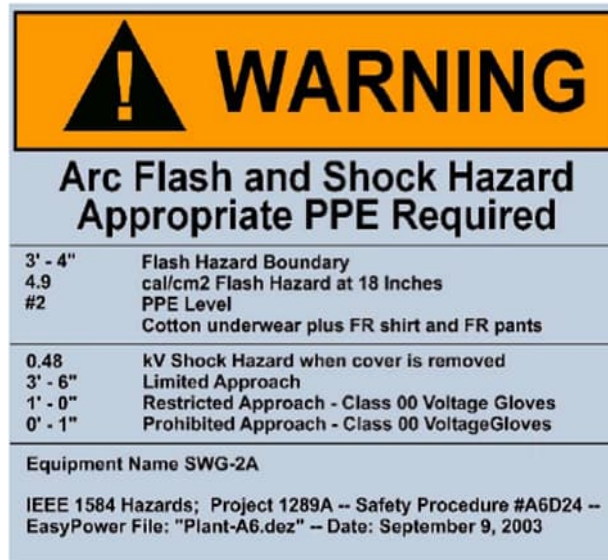


Figure 1
Example Arc Flash Label

SECTION 26 08 00
COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. ASTM International (ASTM):
 - a. D877/D877M, 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. D1298, Standard Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
 - g. D1500, Standard Test Method for ASTM Color of Petroleum Products (ASTM Color Scale).
 - h. D1524, Standard Test Method for Visual Examination of Used Electrical Insulating Liquids in the Field.
 - i. D1533, Standard Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration.
 - j. D1816, Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using VDE Electrodes.
 2. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 43, Recommended Practice for Testing Insulation Resistance of Electric Machinery.
 - b. 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminators Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.
 - c. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
 - d. 95, Recommended Practice for Insulation Testing of AC Electric Machinery (2,300V and Above) with High Direct Voltage.

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- e. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - f. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above.
 - g. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
 - h. C2, National Electrical Safety Code.
 - i. C37.20.1, Standard for Metal-Enclosed Low-Voltage (1,000V ac and below, 3,200V dc and below) Power Circuit Breaker Switchgear.
 - j. C37.20.2, Standard for Metal-Clad Switchgear.
 - k. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
 - l. C37.23, Standard for Metal-Enclosed Bus.
 - m. C62.33, Standard Test Methods and Performance Values for Metal-Oxide Varistor Surge Protective Components.
3. Insulated Cable Engineers Association (ICEA):
 - a. S-93-639, 5-46 kV Shielded Power Cables for Use in the Transmission and Distribution of Electric Energy.
 - b. S-94-649, Concentric Neutral Cables Rated 5 kV through 46 kV.
 - c. S-97-682, Standard for Utility Shielded Power Cables Rated 5 through 46 kV.
 4. InterNational Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems.
 5. National Electrical Manufacturers Association (NEMA):
 - a. AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
 - b. PB 2, Deadfront Distribution Switchboards.
 - c. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70B, Recommended Practice for Electrical Equipment Maintenance.
 - c. 70E, Standard for Electrical Safety in the Workplace.
 - d. 101, Life Safety Code.
 7. National Institute for Certification in Engineering Technologies (NICET).
 8. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.02 SUBMITTALS

A. Informational Submittals:

1. Submit 30 days prior to performing inspections or tests:
 - a. Schedule for performing inspection and tests.
 - b. List of references to be used for each test.
 - c. Sample copy of equipment and materials inspection form(s).
 - d. Sample copy of individual device test form.
 - e. Sample copy of individual system test form.
2. Energization Plan: Prior to initial energization of electrical distribution equipment; include the following:
 - a. The Owner's representative sign-off form for complete and accurate arc flash labeling and proper protective device settings for equipment to be energized.
 - b. Staged sequence of initial energization of electrical equipment.
 - c. Lock-Out-Tag-Out plan for each stage of the progressive energization.
 - d. Barricading, signage, and communication plan notifying personnel of newly energized equipment.
3. Submit test or inspection reports and certificates for each electrical item tested within 30 days after completion of test:
4. Operation and Maintenance Data:
 - a. In accordance with the Owner's Operation and Maintenance Data.
 - b. After test or inspection reports and certificates have been reviewed by the Engineer and returned, insert a copy of each in Operation and Maintenance Manual.
5. Programmable Settings: At completion of Performance Demonstration Test, submit final hardcopy printout and electronic files of as-left setpoints, programs, and device configuration files for:
 - a. Adjustable frequency drives.

1.03 QUALITY ASSURANCE

A. Testing Firm Qualifications:

1. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
2. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having a minimum of 5 years' testing experience on similar projects.
3. Technicians certified by NICET or NETA.
4. Assistants and apprentices assigned to Project at ratio not to exceed two certified to one noncertified assistant or apprentice.

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5. Registered Professional Engineer to provide comprehensive Project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
 6. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories.
- B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.
- C. Test Instrument Calibration: In accordance with NETA ATS.

1.04 SEQUENCING AND SCHEDULING

- A. Perform inspection and electrical tests after equipment listed herein has been installed.
- B. Perform tests with apparatus de-energized whenever feasible.
1. Scheduled with the Owner prior to de-energization.
 2. Minimized to avoid extended period of interruption to the operating plant equipment.
- C. Notify the Owner at least 48 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. Perform tests in accordance with Owner's requirements of Equipment Testing and Facility Startup.
- B. Tests and inspections shall establish:
1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
 2. Installation operates properly.
 3. Equipment is suitable for energization.
 4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

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- D. Set, test, and calibrate circuit breakers, and other applicable devices in accordance with values established by studies as specified in Section 26 05 70, Electrical Systems Analysis.
- E. Adjust mechanisms and moving parts of equipment for free mechanical movement.
- F. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- G. Verify nameplate data for conformance to Contract Documents and approved Submittals.
- H. Realign equipment not properly aligned and correct unlevelness.
- I. Properly anchor electrical equipment found to be inadequately anchored.
- J. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.
- K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- L. Provide proper lubrication of applicable moving parts.
- M. Inform the Owner of working clearances not in accordance with NFPA 70.
- N. Investigate and repair or replace:
 - 1. Electrical items that fail tests.
 - 2. Active components not operating in accordance with manufacturer's instructions.
 - 3. Damaged electrical equipment.
- O. Electrical Enclosures:
 - 1. Remove foreign material and moisture from enclosure interior.
 - 2. Vacuum and wipe clean enclosure interior.
 - 3. Remove corrosion found on metal surfaces.
 - 4. Repair or replace, as determined by the Owner door and panel sections having dented surfaces.
 - 5. Repair or replace, as determined by the Owner poor fitting doors and panel sections.

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6. Repair or replace improperly operating latching, locking, or interlocking devices.
 7. Replace missing or damaged hardware.
 8. Finish:
 - a. Provide matching paint and touch up scratches and mars.
 - b. If required because of extensive damage, as determined by the Owner, refinish entire assembly.
- P. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

3.02 CHECKOUT AND STARTUP

- A. Voltage Field Test:
1. Check voltage at point of termination of power company supply system to Project when installation is essentially complete and is in operation.
 2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
 3. Record supply voltage (all three phases simultaneously on same graph) for 24 hours during normal working day.
 - a. Submit Voltage Field Test Report within 5 days of test.
 4. Unbalance Corrections:
 - a. Make written request to power company to correct condition if balance (as defined by NEMA) exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4 percent of nominal.
 - b. Obtain written certification from responsible power company official that voltage variations and unbalance are within their normal standards if corrections are not made.
- B. Equipment Line Current Tests:
1. Check line current in each phase for each piece of equipment.
 2. Make line current check after power company has made final adjustments to supply voltage magnitude or balance.
 3. If phase current for a piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.03 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed power cable No. 6 and larger for:
 - a. Physical damage.
 - b. Proper connections in accordance with single-line diagram.
 - c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
 - d. Color coding conformance with specification.
 - e. Proper circuit identification.
2. Mechanical Connections for:
 - a. Proper lug type for conductor material.
 - b. Proper lug installation.
 - c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables for:
 - a. Proper shield grounding.
 - b. Proper terminations.
 - c. Proper circuit identification.
4. Control Cables for:
 - a. Proper termination.
 - b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 6 and Larger:

1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors and 500-volt dc megohmmeter for 300-volt insulated conductors.
 - b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
 - c. Evaluate ohmic values by comparison with conductors of same length and type.
 - d. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.
3. Perform resistance measurements through bolted electrical connections with low-resistance ohmmeter. Identify values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

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- C. Low-voltage cable tests may be performed by installer in lieu of independent testing firm.

3.04 MOLDED AND INSULATED CASE CIRCUIT BREAKERS

- A. General: Inspection and testing limited to circuit breakers rated 70 amperes and larger and to motor circuit protector breakers rated 50 amperes and larger.

- B. Visual and Mechanical Inspection:

- 1. Proper mounting.
- 2. Proper conductor size.
- 3. Feeder designation according to nameplate and one-line diagram.
- 4. Cracked casings.
- 5. Connection bolt torque level in accordance with NETA ATS, Table 100.12.
- 6. Operate breaker to verify smooth operation.
- 7. Compare frame size and trip setting with circuit breaker schedules or one-line diagram.
- 8. Verify that terminals are suitable for 75 degrees C rated insulated conductors.

- C. Electrical Tests:

- 1. Insulation Resistance Tests:
 - a. Utilize 1,000-volt dc megohmmeter for 480-volt and 600-volt circuit breakers and 500-volt dc megohmmeter for 240-volt circuit breakers.
 - b. Pole-to-pole and pole-to-ground with breaker contacts opened for 1 minute.
 - c. Pole-to-pole and pole-to-ground with breaker contacts closed for 1 minute.
 - d. Test values to comply with NETA ATS, Table 100.1.
- 2. Contact Resistance Tests:
 - a. Contact resistance in microhms across each pole.
 - b. Investigate deviation of 50 percent or more from adjacent poles and similar breakers.

3.05 GROUNDING SYSTEMS

- A. Visual and Mechanical Inspection:

- 1. Equipment and circuit grounds in switchboard assemblies for proper connection and tightness.

2. Ground bus connections in switchboard assemblies for proper termination and tightness.
3. Effective transformer core and equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-of-Potential Test:
 - a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
 - b. Main ground electrode system resistance to ground to be no greater than 1 ohm.
2. Two-Point Direct Method Test:
 - a. In accordance with IEEE 81, Section 8.2.1.1 for measurement of ground resistance between main ground system, equipment frames, and system neutral and derived neutral points.
 - b. Equipment ground resistance shall not exceed main ground system resistance by 0.25 ohm.
3. Neutral Bus Isolation:
 - a. Test each neutral bus individually with neutral bonding jumper removed at service entrance or separately derived system.
 - b. Evaluate ohmic values by measuring resistance between ground bus and neutral bus.
 - c. Investigate values less than 50 megohms.

3.06 AC INDUCTION MOTORS

A. General: Inspection and testing limited to motors rated 1/2 hp and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Shaft alignment.
3. Blockage of ventilating air passageways.
4. Operate motor and check for:
 - a. Excessive mechanical and electrical noise.
 - b. Overheating.
 - c. Correct rotation.
 - d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionality and proper operation.

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e. Excessive vibration, in excess of values in NETA ATS, Table 100.10.

5. Check operation of space heaters.

C. Electrical Tests:

1. Insulation Resistance Tests:

a. In accordance with IEEE 43 at test voltages established by NETA ATS, Table 100.1 for:

- 1) Motors above 200 hp for 10-minute duration with resistances tabulated at 30 seconds, 1-minute, and 10 minutes.
- 2) Motors 200 hp and less for 1-minute duration with resistances tabulated at 30 seconds and 60 seconds.

b. Insulation resistance values equal to, or greater than, ohmic values established by manufacturers.

2. Calculate polarization index ratios for motors above 200 hp. Investigate index ratios less than 1.5 for Class A insulation and 2.0 for Class B insulation.

3. Insulation resistance test on insulated bearings in accordance with manufacturer's instructions.

4. Measure running current and voltage, and evaluate relative to load conditions and nameplate full-load amperes.

5. Overpotential Tests:

- a. Applied dc voltage in accordance with IEEE 95.
- b. Limited to 2,300-volt motors rated 1,000 hp and greater.
- c. Test results evaluated on pass/fail basis.

3.07 LOW-VOLTAGE MOTOR CONTROL

A. Visual and Mechanical Inspection:

1. Proper operation of indicating and monitoring devices.

2. Proper overload protection for each motor.

3. Improper blockage of air-cooling passages.

4. Check door and device interlocking system by:

- a. Closure attempt of device when door is in OFF position.
- b. Opening attempt of door when device is in ON position.

5. Check nameplates for proper identification of:

- a. Equipment title and tag number with latest one-line diagram.
- b. Pushbuttons.
- c. Control switches.
- d. Pilot lights.
- e. Circuit breakers.

- f. Indicating meters.
- 6. Verify fuse and circuit breaker sizes and types conform to Contract Documents.
 - a. Ohmic value to be zero.
 - b. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
- 7. Verify performance of each control device and feature furnished as part of motor control center.
- 8. Control Wiring:
 - a. Compare wiring to local and remote control, and protective devices with elementary diagrams.
 - b. Check for proper conductor lacing and bundling.
 - c. Check for proper conductor identification.
 - d. Check for proper conductor lugs and connections.
- 9. Exercise active components.
- 10. Inspect contactors for:
 - a. Correct mechanical operations.
 - b. Correct contact gap, wipe, alignment, and pressure.
 - c. Correct torque of connections.
- 11. Compare overload rating with full-load current for proper size.
- 12. Compare fuse, motor protector, and circuit breaker with motor characteristics and power factor correction capacitors for proper size.

B. Electrical Tests:

- 1. Perform resistance measurements through bolted electrical connections with low-resistance ohmmeter. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
- 2. Insulation Resistance Tests:
 - a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
 - b. Bus section phase-to-phase and phase-to-ground for 1-minute on each phase.
 - c. Contactor phase-to-ground and across open contacts for 1-minute on each phase.
 - d. Starter section phase-to-phase and phase-to-ground on each phase with starter contacts closed and protective devices open.
 - e. Test values to comply with NETA ATS, Table 100.1.
- 3. Current Injection through Overload Unit at 300 Percent of Motor Full-Load Current and Monitor Trip Time:
 - a. Trip time in accordance with manufacturer's published data.
 - b. Investigate values in excess of 120 seconds.

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4. Control Wiring Tests:
 - a. Apply secondary voltage to control power and potential circuits.
 - b. Check voltage levels at each point on terminal board and each device terminal.
 - c. Insulation resistance test at 1,000 volts dc on control wiring, except that connected to solid state components; 1-megohm minimum insulation resistance.
5. Operational test by initiating control devices to affect proper operation.

END OF SECTION

SECTION 26 09 13
POWER MEASUREMENT AND CONTROL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American National Standards Institute (ANSI).
 2. Institute for Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
 - b. C37.90.1, Standard for Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.
 - c. C57.13, Standard Requirements for Instrument Transformers.
 3. International Electrotechnical Commission (IEC):
 - a. 60255-26, Measuring Relays and Protection Equipment—Part 26: Electromagnetic Compatibility Requirements.
 - b. 60870-5-104, Telecontrol Equipment and Systems—Part 5-104: Transmission Protocols—Network Access for IEC 60870-5-101 Using Standard Transport Profiles.
 - c. 61850, Communication Networks and Systems for Power Utility Automation.
 4. National Electrical Manufacturers Association (NEMA):
 - a. C12.1, Electric Meters Code for Electricity Metering.
 - b. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 5. Telecommunications Industry Association (TIA):
 - a. 232-F, Interface between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 - b. 485-A, Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems.

1.02 DEFINITIONS

- A. CT: Current Transformer.
- B. DNP: Distributed Network Protocol.
- C. LCD: Liquid Crystal Display.

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- D. LED: Light Emitting Diode.
- E. MPR: Motor Protection Relay.
- F. PLC: Programmable Logic Controller.
- G. PT: Potential Transformer.
- H. RTD: Resistance Temperature Detectors.
- I. UCA: Utility Communications Architecture.

1.03 SUBMITTALS

A. Action Submittals:

1. Instruction manuals for each type of device.
2. Special features, licensed programming software.
3. Potential and current schematic diagrams.
4. Control and metering schematic diagrams.
5. Interconnection wiring diagrams.
6. Installation and mounting requirements.
7. Complete descriptive literature and renewal parts data.

B. Informational Submittals:

1. Programming software used to configure devices, along with settings files necessary to reload or revise settings as left by Contractor.
2. Operation and Maintenance Data.

PART 2 PRODUCTS

2.01 MOTOR PROTECTION RELAY (MPR)

A. General:

1. Multifunction, microprocessor based, programmable digital device.
2. Single, self-contained, door-mounted unit with data input pushbuttons on face of relay.
3. Motor protection against overload, overtemperature, phase reversal, phase unbalance, single-phase, ground fault, jam, underload, and bearing overtemperature, plus starts per hour, differential relay input.
4. Standard thermal curves self-generated within module based on motor data.
5. Motor current integrated with winding temperatures to establish trip times.

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6. Separate trip points for each function.
7. Visual display to indicate relay status and operation.
8. Read out to include real-time motor data using pushbuttons.
9. System data and trip limit points accessible from same display.
10. Nonchangeable trip limit points, except with program jumper.
11. Separate alarm, auxiliary, and trip output contacts rated 8 amperes, 230 volts.
12. Alarm contacts wired to remote alarm indicator.
13. Interconnecting wires terminated on terminal boards.

B. Protective Features:

1. Time overcurrent and instantaneous trip functions.
2. Winding temperature, motor bearing, and driven equipment bearing RTD software set and adjustable trip and alarm levels.
3. Ground fault alarm and trip.
4. Load jam overcurrent and load loss undercurrent.
5. Unbalanced current trip and alarm.
6. Current trip for phase reversal and phase loss.
7. Starts per hour limit.
8. Differential relay input.
9. Overvoltage and undervoltage protection.
10. Voltage trip for phase loss and phase sequence.
11. Trip and alarm independently adjustable.
12. Loss of protection.
13. Measurement and display.
14. Three-phase line and percent full load currents.
15. Three-phase line voltage.
16. kVA and kW.
17. Ground current.
18. Current unbalance at trip condition only.
19. RTD temperatures and hottest RTD.
20. Normal operating conditions and trip annunciators.

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C. Module Features:

1. Programmable trip, alarm, and auxiliary relays.
2. Relay status.
3. Settable CT ratio.
4. Hold system values at trip.
5. Communications output.

D. Manufacturers and Products: Schweitzer Engineering Laboratories; SEL-710.

2.02 ANALOG METERS AND INSTRUMENTS

A. General:

1. Semi-flush mounted, switchboard type.
2. Suitable for mounting on hinged steel panels.
3. Case: Dust-tight, enclosed, with dull black finish.
4. Shape: Square or rectangular.
5. Complete with resistors, reactors, and necessary auxiliaries.
6. 1 percent accuracy.
7. Antiparallax scales with convex clear glass shadow-proof covers for indicating meters and relays.
8. White dials with black points and markings.
9. Indicating Scale: 250-degree circular, nominal.
10. Zero Adjustment: External zero capability.

B. Instrument and Control Switches:

1. Type: Rotary, cam-operated, with two contacts per stage.
2. Silver contacts and maintained positive contact position.
3. Wiping action closing contacts.
4. Adjacent contacts separated by barriers.
5. Contact assembly enclosed in removable cover.
6. Rating: Minimum 20 amperes with 600-volt insulation.
7. Marked escutcheon plates.
8. Operating Handles:
 - a. Power Circuit Breaker Control: Pistol grip.
 - b. Instrument Switches: Round knurled handles.
 - c. Voltmeter Switches: Four-position, phase-to-phase voltage, and OFF.
 - d. Ammeter Switches: Four-position, three-phase currents, and OFF.
 - e. Transfer and Auxiliary Switches: Oval type with arrow.

9. Circuit Breaker Switches:
 - a. Momentary contact, spring-return type.
 - b. Operation indicator to show last operation.
 - c. Indicating Lights:
 - 1) Red to indicate closing.
 - 2) Green to indicate open.
 - 3) White to indicate tripped.
 - 4) Switchboard type with series resistors.
 - d. Mechanical key interlock for locking in OFF position.
 10. Test Switches for Instrument and Current Sources:
 - a. Back connected with clear plastic covers.
 - b. Test jacks in phases for current test switches.
 - c. Four-pole units for both current and voltage.
- C. Indicating Instruments and Meters:
1. Register Size: 6.9-inch scale length, 250-degree arc.
 2. ac Voltmeters:
 - a. Full-scale rating 150-volt movement calibrated for 15,000 volts, 60-Hz.
 - b. Taut-suspension type.
 3. ac Ammeters:
 - a. Full-scale rating 5-ampere movement.
 - b. Taut-suspension type.
 4. Wattmeters and Varmeters:
 - a. Rated 5 amperes at 120 volts.
 - b. Taut-suspension type with built-in watt and var transducer.
 - c. Register: Clock.
 - d. Elements: Two.
- D. Metering Transducers:
1. In accordance with IEC 60688.
 2. Inputs: 115 volts nominal, 5 amperes, 60-Hz.
 3. Output: 4 mA to 20 mA dc into variable loads as established by manufacturer.
 4. Withstand:
 - a. IEEE C37.90.1 surge capability tests.
 - b. Minimum of 1,500-volt rms between input, output, and case.
 5. Maximum Ripple: 1 percent dc peak-to-peak output.
 6. Step Change Input Response: Within 400 milliseconds.
 7. Operating Temperature Range: Minus 20 degrees C to plus 60 degrees C.
 8. Circuitry: Solid state, with calibration and zero adjustment.

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9. Enclosure: Steel, suitable for back mounting.
10. Screw type barrier terminal blocks plus enclosure grounding terminal.
11. Transducers: Voltage current watt var and frequency.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's written instructions.
- B. As defined in Section 26 08 00, Commissioning of Electrical Systems.

3.02 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative: Present at site the following:
 1. Enter, confirm, and assist in testing protective relay settings and communications configuration at the distribution equipment. Device settings to be based on values generated in the device coordination study.
 2. Initial energization and start-up of distribution system equipment.
 3. Post-startup training of the Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the Engineer.

END OF SECTION

SECTION 26 20 00
LOW-VOLTAGE AC INDUCTION MOTORS

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. This section applies to low-voltage AC induction motors, whether or not referenced by a motor-driven equipment specification. If equipment specification section deviates from this section in requirements such as, application, horsepower, enclosure type, mounting, shaft type, or synchronous speed, then those listed requirements shall take precedence over this section.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Bearing Manufacturers Association (ABMA):
 - a. 9, Load Ratings and Fatigue Life for Ball Bearings.
 - b. 11, Load Ratings and Fatigue Life for Roller Bearings.
 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
 - b. 620, Guide for the Presentation of Thermal Limit Curves for Squirrel Cage Induction Machines.
 - c. 841, Standard for Petroleum and Chemical Industry—Premium Efficiency Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors—Up to and Including 370 kW (500 hp).
 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C50.41, Polyphase Induction Motors for Power Generating Stations.
 - c. MG 1, Motors and Generators.
 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 5. UL:
 - a. 83, Standard for Safety for Thermoplastic-Insulated Wire and Cables.
 - b. 674, Standard for Safety for Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.
 - c. 2111, Standard for Safety for Overheating Protection for Motors.

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1.03 DEFINITIONS

- A. EXP: Explosion-proof enclosure.
- B. Inverter Duty Motor: Motor meeting applicable requirements of NEMA MG 1, Section IV, Part 30 and Part 31.
- C. Motor Nameplate Horsepower: That rating after any derating required to allow for extra heating caused by the harmonic content in the voltage applied to the motor by its controller.
- D. TEFC: Totally enclosed, fan-cooled enclosure.
- E. TENV: Totally enclosed, nonventilated enclosure.
- F. VPI: Vacuum pressure impregnated.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Descriptive information.
 - 2. Nameplate data in accordance with NEMA MG 1.
 - 3. Additional Rating Information:
 - a. Service factor.
 - b. Locked rotor current.
 - c. No load current.
 - d. Safe stall time for motors 40 hp and larger.
 - e. Multispeed load classification (for example, variable torque).
 - f. Adjustable frequency drive motor load classification (for example, variable torque) and minimum allowable motor speed for that load classification.
 - g. Guaranteed minimum full load efficiency and power factor.
 - 4. Enclosure type and mounting (such as, horizontal, vertical).
 - 5. Dimensions and total weight.
 - 6. Conduit box dimensions and usable volume as defined in NEMA MG 1 and NFPA 70.
 - 7. Bearing type.
 - 8. Bearing lubrication.
 - 9. Bearing life.
 - 10. Space heater voltage and watts.
 - 11. Description, ratings, and wiring diagram of motor thermal protection.
 - 12. Motor sound power level in accordance with NEMA MG 1.

13. Maximum brake horsepower required by the equipment driven by the motor.
 14. Anchorage and bracing data sheets and drawings.
- B. Informational Submittals:
1. Factory test reports for motors 100 hp and larger.
 2. Anchorage and bracing calculations by equipment manufacturer. Calculations shall be stamped by a registered Professional Engineer in the State of Utah. See Drawings for seismic structural design criteria.
 3. Component and attachment testing seismic certificate of compliance.
 4. Operation and Maintenance Data.
 5. Manufacturer's Certificate of Proper Installation, in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 GENERAL

- A. For multiple units of the same type of equipment, furnish identical motors and accessories of a single manufacturer.
- B. In order to obtain single source responsibility, use a single supplier to provide drive motor, its driven equipment, and specified motor accessories.
- C. Meet requirements of NEMA MG 1.
- D. For motors used in hazardous (classified) locations, Class I, Division 1, Groups B, C, and D, and Class II, Division 1, Groups E, F, and G provide motors that conform to UL 674 and have an applied UL listing mark.
- E. Provide motors specifically designed for the use and conditions intended, with a NEMA design letter classification to fit the application.
- F. Lifting lugs on motors weighing 100 pounds or more.
- G. Coordinate with pump and motor manufacturer for a coordinated operating system, including pump, drive, and speed controller, referenced in Section 44 42 56.10, Horizontal End Suction Centrifugal Pumps.

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H. Operating Conditions:

1. Maximum ambient temperature not greater than 40 degrees C.
2. Provide motors suitable for operating conditions without reduction in nameplate rated horsepower or exceeding rated temperature rise.
3. Overspeed in either direction in accordance with NEMA MG 1.

2.02 HORSEPOWER RATING

- A. As designated in motor-driven equipment specification.
- B. Constant Speed Applications: Brake horsepower of driven equipment at any operating condition not to exceed motor nameplate horsepower rating, excluding service factor.
- C. Adjustable Frequency and Adjustable Speed Applications (Inverter Duty Motor): Driven equipment brake horsepower at any operating condition not to exceed motor nameplate horsepower rating, excluding service factor.

2.03 SERVICE FACTOR

- A. Inverter-Duty Motors: 1.0 at rated ambient temperature, unless otherwise noted.
- B. Other Motors: 1.15 minimum at rated ambient temperature, unless otherwise noted.

2.04 VOLTAGE AND FREQUENCY RATING

- A. System Frequency: 60 Hz.
- B. Voltage Rating: Unless otherwise indicated in motor-driven equipment specification:

Voltage Rating		
Size	Voltage	Phase
1/2 hp and smaller	115	1
3/4 hp through 400 hp	460	3

- C. Suitable for full-voltage starting.

- D. 100 hp and larger also suitable for reduced voltage starting with 65 percent or 80 percent voltage tap settings on reduced inrush motor starters.
- E. Suitable for accelerating the connected load with supply voltage at motor starter supply terminals dipping to 90 percent of motor rated voltage.

2.05 EFFICIENCY AND POWER FACTOR

- A. For all motors except single-phase, under 1 hp, multispeed, short-time rated and submersible motors, or motors driving gates, valves, elevators, cranes, trolleys, and hoists:
 - 1. Efficiency:
 - a. Tested in accordance with NEMA MG 1, Paragraph 12.59.
 - b. Guaranteed minimum at full load in accordance with NEMA MG 1 Table 12-12, Full-load Efficiencies for NEMA Premium Efficiency Electric Motors Rated 600 Volts or Less (Random Wound), or as indicated in motor-driven equipment specification.
 - 2. Power Factor: Guaranteed minimum at full load shall be manufacturer's standard or as indicated in motor-driven equipment specification.

2.06 LOCKED ROTOR RATINGS

- A. Locked rotor kVA Code F or lower, if motor horsepower not covered by NEMA MG 1 tables.
- B. Safe Stall Time: 12 seconds or greater.

2.07 INSULATION SYSTEMS

- A. Three-phase and Integral Horsepower Motors: Unless otherwise indicated in motor-driven equipment specification, Class B or Class F at nameplate horsepower and designated operating conditions.

2.08 ENCLOSURES

- A. Conform to NEMA MG 1.
- B. TEFC and TENV: Furnish with drain hole with porous drain/weather plug.
- C. Explosion-Proof (EXP):
 - 1. TEFC listed to meet UL 674 and NFPA 70 requirements for Class I, Division 1, Group C and Group D hazardous locations.
 - 2. Drain holes with drain and breather fittings.

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3. Integral thermostat opening on excessive motor temperature in accordance with UL 2111 and NFPA 70.
4. Terminate thermostat leads in terminal box separate from main terminal box.

2.09 TERMINAL (CONDUIT) BOXES

- A. Oversize main terminal boxes for motors.
- B. Diagonally split, rotatable to each of four 90-degree positions. Threaded hubs for conduit attachment.
- C. Except ODP, furnish gaskets between box halves and between box and motor frame.
- D. Minimum usable volume in percentage of that specified in NEMA MG 1, Section 1, Paragraph 4.19 and NFPA 70, Article 430:

Terminal Box Usable Values		
Voltage	Horsepower	Percentage
Below 600	150 through 300	275
Below 600	350 through 600	225

- E. Terminal for connection of equipment grounding wire in each terminal box.
- F. Coordinate motor terminal box conduit entries versus size and quantity of conduits shown on the Drawings.

2.10 BEARINGS AND LUBRICATION

- A. Food-grade lubricants shall be used for equipment and pumps in contact with potable water.
- B. Horizontal Motors:
 1. 3/4 hp and Smaller: Permanently lubricated and sealed ball bearings, or regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
 2. 1 hp through 400 hp: Regreasable ball bearings in labyrinth sealed end bells with removable grease relief plugs.
 3. For Direct Drive Equipment: Minimum 100,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.

4. For Belt Driven Equipment: Minimum 30,000 hours L-10 bearing life for ball and roller bearings as defined in ABMA 9 and ABMA 11.
- C. Regreasable Antifriction Bearings:
1. Readily accessible, grease injection fittings.
 2. Readily accessible, removable grease relief plugs.
- D. Oil Lubrication Systems:
1. Oil reservoirs with sight level gauge.
 2. Oil fill and drain openings with opening plugs.
 3. Provisions for necessary oil circulation and cooling.
- E. Inverter Duty Rated Motors Larger than 50 hp, Bearing Isolation: Provide electrically isolated bearings to prevent stray current damage.

2.11 NOISE

- A. Measured in accordance with NEMA MG 1.
- B. Maximum Sound Level for Motors Controlled by Adjustable Frequency Drive Systems: 3 dBA higher than NEMA MG 1.

2.12 BALANCE AND VIBRATION CONTROL

- A. In accordance with NEMA MG 1, Part 7.

2.13 EQUIPMENT FINISH

- A. External Finish: Prime and finish coat manufacturer's standard.
- B. Internal Finish: Bore and end turns coated with clear polyester or epoxy varnish.

2.14 SPECIAL FEATURES AND ACCESSORIES

- A. Screen Over Air Openings: Corrosion-resistant on motors with ODP, WPI, and WPII enclosures meeting requirements for guarded machine in NEMA MG 1, and attached with stainless steel screws.
- B. Winding Thermal Protection:
 1. Thermistors:
 - a. Motors for constant speed application: 100 hp and larger.
 - b. Motors for adjustable speed application: 40 hp and larger.

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- c. Thermistor embedded in each stator phase winding before winding dip and bake process.
- d. In intimate contact with winding conductors.
- e. Epoxy-potted, solid-state thermistor control module mounted in NEMA 250 Type 4 box on motor, by motor manufacturer, individual thermistor circuits factory-wired to control module or solid-state thermistor control module for mounting in motor controller cabinet, depending on the motor, VFD and control configuration.
- f. Control module rated for 120V ac power supply.
- g. Control module automatically reset contact for external use rated 120V ac, 5 amps minimum, opening on abnormally high winding temperature. Provide manual reset at motor controller.

C. Nameplates:

- 1. Raised or stamped letters on stainless steel or aluminum.
- 2. Display motor data required by NEMA MG 1, Paragraph 10.39 and Paragraph 10.40 in addition to bearing numbers for both bearings.
- 3. Premium efficiency motor nameplates to display NEMA nominal efficiency, guaranteed minimum efficiency, full load power factor.

D. Anchor Bolts: Provide meeting manufacturer's recommendations and of sufficient size and number for specified seismic condition.

2.15 SPECIAL MOTORS

A. Requirements in this article take precedence over conflicting features specified elsewhere in this section.

B. Inverter Duty Motor:

- 1. Motor Supplied Power by Adjustable Voltage and Adjustable Frequency Drives: Inverter duty rated in accordance with NEMA Part 30 and Part 31.
- 2. Provide winding insulation rated 1,600 peak volts, minimum.
- 3. Meet or exceed NEMA MG 1 corona inception voltage rating.
- 4. Provide one insulated bearing.
- 5. Suitable for operation over entire speed range indicated.
- 6. Provide forced ventilation where speed ratio is greater than published range for motor provided.

7. Shaft Grounding Device, Motors Larger than 20 hp: Furnish with shaft grounding brush or conductive micro fiber shaft grounding ring solidly bonded to grounded motor frame in accordance with manufacturer's recommendations.
 - a. Manufacturers:
 - 1) Grounding Brush: Sohre Turbomachinery, Inc.
 - 2) Grounding Ring: EST-Aegis.

2.16 FACTORY TESTING

A. Tests:

1. In accordance with IEEE 112 for polyphase motors.
2. Routine (production) tests in accordance with NEMA MG 1. Test multispeed motors at all speeds.
3. For energy efficient motors, test efficiency and power factor at 50 percent, 75 percent, and 100 percent of rated horsepower:
 - a. In accordance with IEEE 112, Test Method B, and NEMA MG 1, Paragraph 12.59. and Paragraph 12.60.
 - b. For motors 500 hp and larger where facilities are not available to test by dynamometer (Test Method B), determine efficiency by IEEE 112, Test Method F.

B. Test Report Forms:

1. Routine Tests: IEEE 112, Form A.
2. Efficiency and power factor by Test Method B, IEEE 112, Form A-2, and NEMA MG 1, Table 12-12.
3. Efficiency and power factor by Test Method F, IEEE 112, Forms F-1, F-2, and F-3.
4. Temperature Test: IEEE 112, Form A-2.

PART 3 EXECUTION

3.01 INSTALLATION

- A. In accordance with manufacturer's instructions and recommendations.
- B. Align motor carefully and properly with driven equipment.
- C. Secure equipment to mounting surface with anchor bolts.

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3.02 MANUFACTURER'S SERVICES

- A. Furnish manufacturer's representative at Site, for installation assistance, inspection, equipment testing, and startup assistance for motors larger than 100 hp.

END OF SECTION

SECTION 26 29 23
LOW-VOLTAGE ADJUSTABLE FREQUENCY DRIVE SYSTEM

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Electronic Industries Alliance (EIA): 359-A-1, Special Colors.
 2. Hydraulic Institute Standards (HIS).
 3. Institute of Electrical and Electronics Engineers (IEEE):
 - a. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
 - b. 519, Standard for Harmonic Control in Electrical Power Systems.
 - c. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 4. National Electrical Manufacturer's Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. MG 1, Motors and Generators.
 - c. WC 57, Standard for Control, Thermocouple Extensions, and Instrumentation Cables.
 5. National Fire Protection Association (NFPA): 79, Electrical Standard for Industrial Machinery.

1.02 DEFINITIONS

- A. Terms that may be used in this section:
1. AFD: Adjustable frequency drive.
 2. CMOS: Complementary metal oxide semiconductor.
 3. CSI: Current source inverter.
 4. EMU: Energy monitoring unit.
 5. GTO: Gate turn-off thyristor.
 6. MPR: Motor protection relay.
 7. MTBF: Mean time between failure.
 8. PWM: Pulse width modulation.
 9. ROM: Read only memory.
 10. RTD: Resistance temperature detector.
 11. RTU: Remote Telemetry Unit.
 12. Rated Load: Load specified for equipment.
 13. Rated Speed: Nominal rated (100 percent) speed specified for equipment.

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14. TDD: Total demand distortion.
15. THD: Total harmonic distortion.
16. TTL: Transistor transistor logic.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. Drive system consisting of adjustable frequency controller, drive motor, auxiliary items, and components necessary for complete operating system.
2. Furnish AFDs rated on basis of actual motor full load nameplate current rating times the service factor.
3. Drive System: Convert incoming three-phase, 60-Hz ac power to variable voltage, adjustable frequency output for adjustable speed operation of a standard ac induction squirrel-cage motor, using pulse-width-modulation (PWM) technique to produce adjustable frequency output.
4. System rated for continuous industrial duty and suitable for use with NEMA MG 1, Design B motors.
5. Incoming Line Circuit Breaker: Provide positive means of disconnecting incoming power, and overcurrent protection for drive system.

1.04 SUBMITTALS

A. Action Submittals:

1. Complete system rating, including nameplate data, continuous operation load capability throughout speed range of 0 percent to 120 percent of rated speed.
2. Complete adjustable frequency controller rating coordinated with motor full load nameplate current rating; list controller special features being supplied.
3. Controller, reactor, harmonic filter, and isolating transformer (if applicable) dimensional drawings; information on size and location of space for incoming and outgoing conduit.
4. Maximum heat dissipation from enclosure.
5. Should separate enclosures and equipment be necessary for filter elements or provide complete dimensional information including location of space for incoming and outgoing conduit, weight, maximum heat loss, and minimum current carrying capacity and recommended wire size for required interconnecting circuits.

6. Layout of controller face showing pushbuttons, switches, instruments, and indicating lights.
7. Complete system operating description.
8. Complete system schematic (elementary) wiring diagrams.
9. Complete system interconnection diagrams between controller, drive motor, and related components or controls external to system, including wire numbers and terminal board point identification.
10. One-line diagram of system, including component ratings.
11. Description of diagnostic features being provided.
12. Descriptive literature for control devices such as relays and timers.
13. Itemized bill-of-materials listing system components.
14. Seismic anchorage and bracing drawings and cut sheets.

B. Informational Submittals:

1. Statement of Supplier qualifications.
2. Anchorage and bracing calculations by equipment manufacturer. Calculations shall be stamped by a registered Professional Engineer in the State of Utah. See Drawings for seismic structural design criteria.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's printed installation instructions.
5. Factory functional test reports.
6. Field test reports.
7. Component and attachment testing seismic certificate of compliance as required by AHJ or the Owner.
8. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
9. Operation and Maintenance Data.
10. Manufacturer's Certificate of Proper Installation, in accordance with manufacturer's requirements.

1.05 QUALITY ASSURANCE

- A. Supplier: Minimum 5 years' experience in furnishing similar size and type adjustable frequency, controlled speed, drive systems.

1.06 EXTRA MATERIALS

- A. Furnish for each drive unit: Complete set of components likely to fail in normal service.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Components and accessories specified in this section shall be products of:
1. Galt.
 2. Schneider Electric.

2.02 SUPPLEMENTS

- A. Some specific requirements are attached to this section as supplements.

2.03 SERVICE CONDITIONS

- A. Ambient Operating Temperature: 45 degrees F to 105 degrees F.
- B. Humidity: 0 percent to 95 percent relative (noncondensing).
- C. Altitude: 4,575 feet.
- D. Frequency Stability: Plus or minus 0.1 percent of maximum frequency.

2.04 COMPONENTS

- A. Drive Units:
1. Incorporate switching power supply operating from dc bus, to produce PWM output waveform simulating sine wave and providing power loss ride through of 2 milliseconds at full load, full speed.
 2. Current-limiting semiconductor fuses for protection of internal power semiconductors.
 3. Employ rectifier providing constant displacement power factor of 0.95 minimum at all operating speeds and loads.
 4. Use transistors for output section, providing a minimum 97 percent drive efficiency at full speed, full load.
 5. Employ dc power discharge circuit so that after removal of input power dc link capacitor voltage level will decay below 50 volts dc within 1 minute after de-energizing following and NFPA 79. Design dc link capacitor for a MTBF of 5 years.
 6. Operate with open circuited output.
 7. Input Voltage: 480V ac plus or minus 10 percent.
 8. Output Voltage: 0-volt to 480 volts, three-phase, 0 to 66-Hz, minimum.

9. Short-Time Overload Capacity:
 - a. Variable Torque Applications: 110 percent of rated load in rms current for 1 minute following full load, full speed operation.
 - b. Constant Torque Applications: 150 percent of rated load in rms current for 1-minute following full load, full speed operation.
10. Equipment Short-Circuit Rating: Suitable for connection to system with maximum source three-phase, bolted fault, short-circuit available of 42,000 amps rms symmetrical at 480 volts.
11. Diagnostics: Comprehensive for drive adjustment and troubleshooting:
 - a. Memory battery backup; 100-hour minimum during power loss.
 - b. Status messages will not stop drive from running but will prevent it from starting.
 - c. Fault Condition Messages and History: First fault protection function to be activated, ability to store six successive fault occurrences in order. Minimum faults numerically:
 - 1) Overcurrent (time and instantaneous).
 - 2) Overvoltage.
 - 3) Undervoltage (dc and ac).
 - 4) Overtemperature (drive, motor windings, motor bearing, pump bearing).
 - 5) Serial communication fault.
 - 6) Short-circuit/ground fault (motor and drive).
 - 7) Motor stalled.
 - 8) Semiconductor fault.
 - 9) Microprocessor fault.
 - 10) Single-phase voltage condition.
12. Drive Protection:
 - a. Overcurrent, instantaneous overcurrent trip.
 - b. Dc undervoltage protection, 70 percent dropout.
 - c. Dc overvoltage protection, 130 percent pickup.
 - d. Overtemperature, drive, inverter, converter, and dc link components.
 - e. Overtemperature, motor, and pump.
 - f. Single-phase protection.
 - g. Reset overcurrent protection (manual or automatic reset).
 - h. Active current limit/torque limit protection.
 - i. Semiconductor fault protection.
 - j. Short-circuit/ground fault protection.
 - k. communication fault protection.
 - l. Microprocessor fault.
 - m. Surge protection for transient overvoltage (6,000 volts, 80 joule surge, tested per IEEE C62.41).
 - n. Visual display of specific fault conditions.

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13. Operational Features:
 - a. Use manufacturer's standard unless otherwise indicated.
 - b. Power loss ride through (0.1-second).
 - c. Start on the fly.
 - d. Electronic motor overload protection.
 - e. Stall protection.
 - f. Slip compensation.
 - g. Automatic restart after power return (ability to enable/disable function).
 - h. Critical frequency lockout (three selectable points minimum, by 1.5-Hz steps in 10-Hz bands, to prevent resonance of system).
 - i. Drive maintenance system software for complete programming and diagnostics.
 - j. Ground fault protection, drive, and motor.
 - k. Operate with no motor connected to output terminals.
 - l. Incoming Line Reactor: Provide 3 percent incoming line reactors.
- B. Rectifier: Three-phase 18-pulse rectifier, or active front end drive, to provide constant dc voltage to drive's dc bus.
- C. Furnish series choke and capacitors on dc bus to reduce ripple in rectifier output and to reduce harmonic distortion reflected into incoming power feeders.
- D. Controller: Microprocessor-controller PWM inverter to convert to dc voltage to variable voltage, adjustable frequency, three-phase ac output. Output voltage shall vary proportionally with frequency to maintain constant ratio of volts to hertz up to 60-Hz; above 60-Hz, voltage shall remain constant with drive operating in constant horsepower output mode.
- E. Enclosure:
 1. NEMA 250, Type 1, gasketed, freestanding, enclosure for mounting against wall, completely front accessible, and hinged doors. Properly sized to dissipate heat generated by controller within limits of specified operating conditions (including ambient temperature and ambient airflow). Enclosure not to exceed dimensions shown on the Drawings.
 2. Cable termination compartment door interlocked main circuit breaker, defeatable (lockable in the open position), emergency stop pushbutton, alphanumeric keypad and display, and operator's controls. Components and controls specified in Section 26 05 04, Basic Electrical Materials and Methods.
 3. Wire drive from below and above for power and control wiring.

4. Size forced-ventilation for periodic operation to cool each unit with maximum room ambient temperature of 95 degrees F. Furnish redundant fans such that if one fan fails remaining fans furnish adequate ventilation for drive when operating at maximum capacity. Furnish filters on ventilation intakes.
5. Wiring:
 - a. Bundle stranded copper wiring neatly with nylon tie wraps or with continuous plastic spiral binding.
 - b. Label each terminal for permanent identification of leads.
 - c. Identify each wire at each end with imprinted mylar adhesive-back wire markers.
 - d. Incorporate in as-installed wiring diagrams for wire and terminal numbers shown.
 - e. Wiring across door hinge, use 19-strand, NEMA WC 57 Class C stranding looped for proper twist rather than bending at hinge.
 - f. Wire connections internal to panels by crimp-on terminal types.
 - g. For multiple enclosure systems, complete interconnection wiring with gasketed enclosure openings for wiring.
 - h. Multipoint plug receptacles for control wiring crossing equipment shipping splits.
6. Selector switches, indicating lights, potentiometers, instruments, protective devices, and major system components identified by means of mechanically attached, engraved, laminated nameplates.

F. Operator Interface:

1. Controls: Mount local control on front door of enclosure and include control switch and membrane type keypad for the following operator functions:
 - a. Start (when in local mode).
 - b. Stop (when in local mode).
 - c. Speed increase (when in local mode).
 - d. Speed decrease (when in local mode).
 - e. Parameter mode selection (recall programmed parameters).
 - f. LOCAL/OFF/REMOTE control selection (in remote, furnish for remote RUN command digital input and speed increase/decrease via remote 4 mA to 20 mA analog signal).
 - g. Fault reset, manual for faults, except loss of ac voltage which is automatic upon return.
 - h. RUN/preset speed.
 - i. Parameter lock, password or key switch lockout of changes to parameters.
 - j. Start disable, key switch or programmed code.
 - k. Provide additional control as indicated on the Drawings.

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2. Control circuit disconnect shall de-energize circuits in units that are not de-energized by main power disconnect device.
3. 120 volts, single-phase, 60-Hz circuits for control power and operator controls from internal control power transformer. Furnish power for motor space heaters rated 120 volts.
4. Arrange component and circuit such that failure of a single component cannot cause cascading failure(s) of other component(s).
5. Alphanumeric Display: During normal operation and routine test, the following parameters shall be available:
 - a. Motor current (percent of drive rated current).
 - b. Output frequency (Hertz).
 - c. Output voltage.
 - d. Running time.
 - e. Local/remote indicator.
 - f. Status of digital inputs and outputs.
 - g. Analog input and output values.
 - h. Output motor current per leg.
 - i. All test points.
6. Adjustable Parameters: Set drive operating parameters and indicate in numeric form. Potentiometers may not be used for parameter adjustment. Minimum setup parameters available:
 - a. Frequency range, minimum, maximum.
 - b. Adjustable acceleration/deceleration rate.
 - c. Volts per Hertz (field weakening point).
 - d. Active current limit/torque limit, 0 percent to 140 percent of drive rating.
 - e. Adjustable voltage boost (IR compensation).
 - f. Preset speed (adjustable, preset operating point).
 - g. Provision for adjustment of minimum and maximum pump speed to be furnished as function of 4 mA to 20 mA remote speed signal.

G. Signal Interface:

1. Digital Input:
 - a. Accept a remote RUN command contact closure input.
 - b. High temperature contact closure input from field mounted motor temperature monitoring relay.
2. Digital Output: Furnish three discrete output dry contact closures rated 5 amps at 120V ac.
 - a. DRIVE RUNNING.
 - b. DRIVE FAULT (with common contact closure for all fault conditions).
 - c. DRIVE IN REMOTE MODE.

3. Analog Input: When LOCAL/OFF/REMOTE switch is in REMOTE, control drive speed from remote 4 mA to 20 mA dc signal.
 - a. Make provisions for adjustment of minimum and maximum motor speed which shall result from this signal.
 - b. Factory set this adjustment to comply with operating speed range designated in driven equipment specifications.
 - c. Frequency resolution shall be 0.1 percent of base speed.
 - d. Accept second analog input from speed transmitter located on motor shaft.
4. Analog Output: Furnish two 4 mA to 20 mA dc signals for actual frequency, actual load.
5. Network Communications: ModBus TCP communications shall be provided and capable of communicating the signal interfaces listed above..

H. Accessories:

1. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in readily visible location.
2. Lifting Lugs: Equipment weighing over 100 pounds.
3. Anchor Bolts: Galvanized, Type 316 stainless steel, sized by equipment manufacturer,.

2.05 FACTORY FINISHING

A. Enclosure:

1. Primer: One coat of rust-inhibiting coating.
2. Finish:
 - a. Interior: One coat white enamel.
 - b. Exterior: One coat manufacturer's standard gray enamel or EIA 359-A-1, No. 61.
3. Manufacturer's standard enamel finish.

2.06 SOURCE QUALITY CONTROL

- A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.
- B. Factory Tests and Adjustments: Test one control panel actually furnished.
- C. Record test data for report.

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- D. Functional Test: Perform manufacturer's standard tests.
- E. Motor Test: See Section 26 20 00, Low-Voltage AC Induction Motors.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.

3.02 FIELD QUALITY CONTROL

- A. Functional Test:
 - 1. Conduct on each controller.
 - 2. Inspect controller for electrical supply termination connections, interconnections, proper installation, and quiet operation.
 - 3. Record test data for report.
- B. Performance Test:
 - 1. Conduct on each controller.
 - 2. Perform under actual or approved simulated operating conditions.
 - 3. Test for continuous 12-hour period without malfunction.
 - 4. Demonstrate performance by operating continuous period while varying application load, as input conditions allow, to verify system performance.

3.03 MANUFACTURERS' SERVICES

- A. Manufacturer's Representative: Present at Site or classroom designated by the Owner for installation assistance, inspection, functional and performance testing, completion of Manufacturer's Certificate of Proper Installation, prestartup classroom or Site training, facility startup and post-startup training.

END OF SECTION

SECTION 33 13 00
DISINFECTION OF WATER UTILITY DISTRIBUTION FACILITIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
 - a. B300, Hypochlorites.
 - b. B301, Liquid Chlorine.
 - c. B302, Ammonium Sulfate.
 - d. B303, Sodium Chlorite.
 - e. C651, Disinfecting Water Mains.
 - f. C652, Disinfection of Water Storage Facilities.
 - g. C653, Disinfection of Water Treatment Plants.
2. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.
3. Standard Methods for the Examination of Water and Wastewater, as published by American Public Health Association, American Water Works Association, and the Water Environment Federation.

1.02 SUBMITTALS

A. Informational Submittals:

1. Plan describing and illustrating conformance to appropriate AWWA standards and this Specification.
2. Procedure and plan for cleaning system.
3. Procedures and plans for disinfection and testing.
4. Proposed locations within system where Samples will be taken.
5. Type of disinfecting solution and method of preparation.
6. Method of disposal for highly chlorinated disinfecting water.
7. Independent Testing Agency: Certification that testing agency is qualified to perform chlorine concentration testing, and bacteriological testing in accordance with AWWA standards, State of Utah requirements, and this Specification.
8. Certified Bacteriological Test Results:
 - a. Facility tested is free from coliform bacteria contamination.
 - b. Forward results directly to Owner and Engineer.

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1.03 QUALITY ASSURANCE

- A. Independent Testing Agency: Certified in the State of Utah, with 10 years' experience in field of water sampling and testing. Agency shall use calibrated testing instruments and equipment and documented standard procedures for performing specified testing.

1.04 SEQUENCING

- A. Commence initial disinfection after completion of following: Hydrostatic and pneumatic testing, pressure testing, functional and performance testing and acceptance of pipelines, pumping systems, structures, and equipment.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER FOR DISINFECTION AND TESTING

- A. Clean, uncontaminated, and potable.
- B. The Owner will provide water for testing.

PART 3 EXECUTION

3.01 GENERAL

- A. Conform to AWWA C651 for pipes and pipelines, except as modified in these Specifications.
- B. Contractor's Equipment:
 - 1. Furnish chemicals and equipment, such as pumps and hoses, to accomplish disinfection.
 - 2. Water used to fill pipeline may be supplied using a temporary connection to existing distribution system. Provide protection against cross-connections as required by AWWA C651.

- C. Disinfect the following items installed or modified under this Project, intended to hold, transport, or otherwise contact potable water:
 - 1. Piping: Disinfect new piping that connect to existing pipelines up to point of connection.
 - 2. Disinfect surfaces of materials that will contact finished water, both during and following construction, using one of the methods described in AWWA C652 and AWWA C653. Disinfect prior to contact with finished water. Take care to avoid recontamination following disinfection.
- D. Prior to application of disinfectants, clean pipelines of loose and suspended material.
- E. Allow freshwater and disinfectant solution to flow into pipe or vessel at a measured rate so chlorine-water solution is at specified strength. Do not place concentrated liquid commercial disinfectant in pipeline or other facilities to be disinfected before it is filled with water.

3.02 TURBIDITY

- A. Cleaning of equipment and facilities shall include removal of materials that result in a turbidity exceeding limits stated in Article Testing.

3.03 PIPELINES

- A. Cleaning:
 - 1. Before disinfecting, clean foreign matter from pipe in accordance with AWWA C651.
 - 2. If continuous feed method or slug method of disinfection, as described in AWWA C651, are used flush pipelines with potable water until clear of suspended solids and color. Provide hoses, temporary pipes, ditches, and other conduits as needed to dispose of flushing water without damage to adjacent properties.
 - 3. Flush service connections and hydrants. Flush distribution lines prior to flushing hydrants and service connections. Operate valves during flushing process at least twice during each flush.
 - 4. Flush pipe through flushing branches and remove branches after flushing is completed.
- B. Disinfecting Procedure: In accordance with AWWA C651, unless herein modified.

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3.04 DISPOSAL OF CHLORINATED WATER

- A. Do not allow flow into a waterway without neutralizing disinfectant residual.
- B. See appendix of AWWA C651 for acceptable neutralization methods.

3.05 TESTING

- A. Collection of Samples:
 - 1. Coordinate activities to allow Samples to be taken in accordance with this Specification.
 - 2. Provide valves at sampling points.
 - 3. Provide access to sampling points.
- B. Test Equipment:
 - 1. Clean containers and equipment used in sampling and make sure they are free of contamination.
 - 2. Obtain sampling bottles with instructions for handling from Owner's laboratory.
- C. Chlorine Concentration Sampling and Analysis: Collect and analyze Samples in accordance with AWWA C651.
- D. After pipelines have been cleaned, disinfected, and refilled with potable water.
- E. If minimum Samples required above are bacterially positive, disinfecting procedures and bacteriological testing shall be repeated until bacterial limits are met.

END OF SECTION

**SECTION 40 27 02
VALVES AND OPERATORS**

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Class 25, Class 125, and Class 250).
 - b. B16.44, Manually Operated Metallic Gas Valves for Use in Aboveground Piping Systems up to 5 pounds per square inch.
 2. American Water Works Association (AWWA):
 - a. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - b. C500, Metal-Seated Gate Valves for Water Supply Service.
 - c. C504, Rubber-Seated Butterfly Valves.
 - d. C507, Ball Valves, 6 inches Through 48 inches (150 mm Through 1200 mm).
 - e. C508, Swing-Check Valves for Waterworks Service, 2-inch through 24-inch (50 mm Through 600 mm) NPS.
 - f. C509, Resilient-Seated Gate Valves for Water Supply Service.
 - g. C510, Double Check Valve, Backflow Prevention Assembly.
 - h. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
 - i. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
 - j. C515, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
 - k. C550, Protective Interior Coatings for Valves and Hydrants.
 - l. C606, Grooved and Shouldered Joints.
 - m. C800, Underground Service Line Valves and Fittings.
 3. ASTM International (ASTM):
 - a. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - c. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
 - d. B61, Standard Specification for Steam or Valve Bronze Castings.
 - e. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

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- f. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
 - g. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
 - h. B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
 - i. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
 - j. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
 - k. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
 - l. D429, Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates.
 - m. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- 4. Food and Drug Administration (FDA).
 - 5. Manufacturers Standardization Society (MSS):
 - a. SP 80, Bronze Gate, Globe, Angle and Check Valves.
 - b. SP 81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
 - c. SP 85, Gray Iron Globe & Angle Valves, Flanged and Threaded Ends.
 - d. SP 88, Diaphragm Valves.
 - e. SP 110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
 - 6. NSF International (NSF): 61, Drinking Water System Components-Health Effects.
 - 7. UL.
 - 8. USC Foundation for Cross-Connection Control and Hydraulic Research.

1.02 SUBMITTALS

A. Action Submittals:

- 1. Shop Drawings:
 - a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
 - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - c. Power and control wiring diagrams, including terminals and numbers.
 - d. Complete motor nameplate data.

- e. Complete electric motor actuators submittal data.
- f. Sizing calculations for open-close/throttle and modulating valves.

B. Informational Submittals:

- 1. Manufacturer's Certificate of Compliance, in accordance with Section 01 43 33, Manufacturers' Field Services, for butterfly valves, full compliance with AWWA C504.
- 2. Certification for compliance to NSF 61 for valves used for drinking water service.
- 3. Tests and inspection data.
- 4. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
- 5. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

PART 2 PRODUCTS

2.01 GENERAL

- A. Valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, operating nut, worm and gear operator, chain, wrench, and accessories to allow a complete operation from the intended operating level.
- B. Valve to be suitable for intended service. Renewable parts not to be of a lower quality than specified.
- C. Valve same size as adjoining pipe, unless otherwise called out on the Drawings.
- D. Valve ends to suit adjacent piping.
- E. Resilient seated valves shall have no leakage (drip-tight) in either direction at valve rated design pressure. All other valves shall have no leakage (drip-tight) in either direction at valve rated design pressure, unless otherwise allowed for in this section or in stated valve standard.
- F. Size operators and actuators to operate valve for the full range of pressures and velocities.
- G. Valve to open by turning counterclockwise.
- H. Factory mount operator, actuator, and accessories.

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- I. Owner may accept valves as “equal” if, in Owner’s judgement, they meet project-specific needs even if they don’t meet all specified requirements.
- J. Flanges and bolting shall mate properly at valves and piping flanges and meet all pressure requirements. Submit coordinated flanges, bolting and gaskets.
- K. Flanges on valves shall be faced and prepared to seal with the specified gaskets. If special gaskets are required, notify the Engineer immediately and identify requirements on the submittals. Provide the required gaskets, either the standard gaskets as specified, or specialty gaskets that may be required by the valve manufacturer.
- L. Valves shall mate to standard AWWA or ASME flanges as specified. Coordinate mating surface between valves and piping. Any exposed flange surfaces, not covered by a sealing gasket, shall be coated to prevent corrosion.

2.02 MATERIALS

- A. Bronze and brass valve components and accessories that have surfaces in contact with water to be alloys containing less than 16 percent zinc and 2 percent aluminum.
 - 1. Approved alloys are of the following ASTM designations: B61, B62, B98/B98M (Alloy UNS No. C65100, No. C65500, or No. C66100), B139 (Alloy UNS No. C51000), B584 (Alloy UNS No. C90300 or C94700), B164, B194, and B127.
 - 2. Stainless steel Alloy 18-8 may be substituted for bronze.
- B. Valve materials in contact with or intended for drinking water service to meet the following requirements:
 - 1. Comply with requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements.
 - 2. Coatings materials to be formulated from materials deemed acceptable to NSF 61.
 - 3. Furnish certification that product is certified as suitable for contact with drinking water by an accredited certification organization in accordance with NSF 61. Provide certification for each valve type used for drinking water service.

2.03 FACTORY FINISHING

A. Epoxy Lining and Coating:

1. In accordance with AWWA C550 unless otherwise specified.
2. Either two-part liquid material or heat-activated (fusion) material except only heat-activated material if specified as “fusion” or “fusion bonded” epoxy.
3. Minimum 7-mil dry film thickness except where limited by valve operating tolerances.

B. Exposed Valves:

1. In accordance with Section 09 90 00, Painting and Coating.
2. Safety isolation valves and lockout valves with handles, handwheels, or chain wheels “safety yellow.”

2.04 VALVES

A. Gate Valves:

1. General:

- a. AWWA gate valves to be in full compliance with stated AWWA standard and the following requirements:
 - 1) Provide 2-inch operating nut and handwheel for AWWA gate valves 12 inches and smaller.
 - 2) Provide totally enclosed spur or bevel gear operator with indicator for AWWA gate valves 14 inches and larger.
 - 3) Provide Affidavit of Compliance per the applicable AWWA standard for AWWA gate valves.
 - 4) Mark AWWA gate valves with manufacturer’s name or mark, year of valve casting, valve size, and working water pressure.
 - 5) Repaired AWWA gate valves shall not be submitted or supplied.
 - 6) AWWA C509 and AWWA C515 valves may be substituted for each other.

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2. Type V130 Resilient Seated Gate Valve 3 Inches to 20 Inches:
 - a. Ductile iron body, resilient seat, bronze stem and stem nut, ANSI Class 125 flanged ends, nonrising stem (with 2-inch operating nut), in accordance with AWWA C509, minimum design working water pressure 175 pounds per square inch gauge, full port, fusion-epoxy coated inside and outside per AWWA C550, NSF 61 certified. Each valve shall be drip tight in both directions. For all buried valves, provide valve box and extension rod to the surface per drawing details. For all non-buried valves, provide handwheel. Provide manual position indicator switch.
 - b. Manufacturers and Products:
 - 1) Mueller; 2300 Series Resilient Wedge Gate Valve.
 - 2) Clow; 2600 Series Resilient Wedge Gate Valve.
 - 3) "Or-equal."

B. Ball Valves:

1. Type V307 SST Ball Valve 3 Inches and Smaller: Two or three-piece, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body and end pieces, full port Type 316 stainless steel ball, threaded ends, reinforced PTFE seats, body seal and stem packing, blowout-proof stainless-steel stem, stainless-steel lever operator with vinyl grip, rated 1,000-pound WOG, 150 pounds per square inch SWP. Valves shall be rated drip tight to 250 pounds per square inch cold water pressure.
 - a. Manufacturers and Products:
 - 1) Milwaukee; 30 Series.
 - 2) Nibco; T-595-S6-R-66-LL.
 - 3) Conbraco Apollo; 86-500 Series.

C. Butterfly Valves:

1. General:
 - a. In full compliance with AWWA C504 and following requirements:
 - 1) Suitable for throttling and isolation operations and infrequent operation after periods of inactivity.
 - 2) The butterfly valve shall be of the double offset or triple offset design whereby the elastomeric seat is not in compression at any degree of opening except at full closure.
 - 3) All valves unless noted otherwise, shall be sized for bi-directional water service, full rated pressure and a line velocity of 16 feet per second.

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- 4) Valves shall be zero leakage with rated 250 pounds per square inch pressure applied in shop tests across closed valve in each direction. Valves shall be zero leakage across closed valve during field test to rated system pressure in each direction.
 - 5) No travel stops for disc on interior of body.
 - 6) Isolate metal-to-metal thrust bearing surfaces from flowstream.
 - 7) Provide worm gear actuator with handwheel. Valve actuators to meet the requirements of AWWA C504.
 - 8) Buried service operators shall withstand 450-foot-pounds of input torque at fully open and fully closed positions.
 - 9) Unless otherwise indicated, all manually actuated butterfly valves shall be equipped with a hand wheel and 2-inch square actuating nut and position indicator.
 - 10) Provide linings and coatings per AWWA, unless otherwise indicated on Drawings or specified herein.
 - 11) Valves to be in full compliance with NSF 61. Provide NSF 61 certificate for each valve.
2. Type V504 Butterfly Valve Water Works Service 3 Inches to 48 Inches:
- a. AWWA C504, Class 250B. ANSI B16.1 class 125-pound flanges compatible with AWWA Class D flanges.
 - b. This valve will be manually actuated with a 2-inch operating nut and handwheel.
 - c. Provide 30-inch valves with 12-inch lay length.
 - d. Elastomeric Seal: Provide EPDM valve seat as one continuous 360-degree ring mounted on valve disc with Type 316 stainless steel fasteners that do not penetrate EPDM. Seat shall be field replaceable and adjustable in line without requiring special tools or skills or more than 8 hours. Seats with hardened epoxy or grout in a dovetailed groove are not allowed.
 - e. Body: Ductile iron per ASTM A536 65-45-12 or ASTM A536 60-40-18. Shear-stress-vulnerable cast iron is not allowed. Valve body shall have stainless steel stamped or engraved tag indicating manufacturer and build data. Valve build data shall be made available upon request by the Owner and shall be retained by the manufacturer for no less than 2 times the expected valve life.

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- f. Disc: Ductile iron for valves sizes 3 inches to 20 inches. Ductile iron, ASTM A536 65-45-12 or ASTM A536 60-40-18 for valves 24 inches and larger. Disc elastomeric seal retainer shall be Type 316 stainless steel. Fasten disc to the valve shaft with tangential stainless steel shaft pins, Type 316 or higher alloy. Mechanically retain disc pins which extend completely through valve.
- g. Shaft: Valve shafts shall be ASTM A276 Type 316 stainless steel. Shaft material shall be suitable for application pressure and velocity.
- h. Metallic Seat: Stainless steel alloy valve seat shall be located in valve body. There shall be no gap between the valve body and metallic body seat and consequently no potential for corrosion or lifting of seat. Attach seat by high alloy weld overlay process.
- i. Shaft Seals: Provide multi O-ring seals protecting both inside and outside and inside of shaft. Seals shall not need periodic manual adjustment. Seals shall prevent pressurized water from entering uncoated valve disc hub and valve body shaft bore. Seals shall keep valve shaft un-wetted and unpressurized so actuator may be removed without dewatering the pipeline. Seals shall prevent debris and pressurized water from entering uncoated valve body shaft bore and prevent valve exterior water or contaminations from entering via valve if the pipe experiences a vacuum event. Seal shall prevent an ingress breach if external hydrostatic forces exceed pipe internal pressure. Manual pulldown packing glands or braided packing are not allowed. Outer shaft seals shall be replaceable cartridge type, bolted to valve body and shall not be held in place with an adapter plate or by valve actuator.
- j. Shaft Bearings: Shaft bearings shall be corrosion resistant, self-lubricating sleeve type made of bronze, stainless steel or stainless steel backed PTFE. Bearing choice and bearing friction shall be correctly added to valve input torque requirements.
- k. Strength: The proportion and dimensions of all parts of the valve and actuator shall be designed to withstand, without failure, the stresses occurring under the testing and operating conditions. The maximum allowable stress in any material shall not exceed 1/5 of the ultimate tensile strength or 1/3 of the minimum yield strength. Class 150 valves shall be capable of withstanding a one-time pressure test of 300 pounds per square inch applied to one side of the disc with zero pressure applied to the other side of the disc while in the closed position, without damage or permanent deformation to any part of the valve, seat, disc or shaft. The valve shall be capable of withstanding such pressures in both directions.
- l. All fasteners and hardware shall be Type 316 stainless steel.

- m. Paint and Coatings:
 - 1) Valves 24 Inches and Smaller: Fusion bonded epoxy line and coat all external and internal surfaces (except seating surface). Coating damaged in shipping or installation shall be noted and properly repaired.
 - 2) Valves Larger than 24 Inches: All external and internal surfaces shall be coated with a minimum of 10 mils of an NSF61 approved two part liquid epoxy. All sharp edges to be coated shall be beveled/radiused to assure consistent coating thickness. The coating inspection report will include inspection of at least six locations where the edges are most sharp and through the complete circumference of the disc edge to assure proper coating and compliance. Compliance of proper beveling of all sharp edges with proper coating of carbon steel valves will be strictly enforced as a condition of providing a proper continuous water service valve.
- n. Manufacturers and Products:
 - 1) VAG Armaturen - Evanston Illinois/Manheim Germany, VAG EKN (double eccentric rubber seated).
 - 2) AVTEK DEX Double Eccentric Butterfly Valve.
 - 3) "Or-equal."

2.05 OPERATORS AND ACTUATORS

A. Manual Operators:

- 1. General:
 - a. For AWWA valves, operator force not to exceed requirements of the applicable valve standard.
 - b. For non-AWWA valves, operator force not to exceed applicable industry standard or 80 pounds, whichever is less, under any operating condition, including initial breakaway. Provide gear reduction operator when force exceeds requirements.
 - c. Operator self-locking type or equipped with self-locking device.
 - d. Position indicator on quarter-turn valves.
 - e. Worm and gear operators one-piece design, worm-gears of gear bronze material. Worm of hardened alloy steel with thread ground and polished. Traveling nut type operator's threaded steel reach rod with internally threaded bronze or ductile iron nut.
- 2. Exposed Operator:
 - a. Galvanized and painted handwheel.
 - b. Cranks on gear type operator.

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- c. Chain wheel operator with tieback, extension stem, floor stand, and other accessories to permit operation from normal operation level.
- d. Valve handles to take a padlock, and wheels a chain and padlock.
- 3. Buried Operator:
 - a. Buried service operators on valves larger than 2-1/2 inches shall have a 2-inch AWWA operating nut. Buried operators on valves 2 inches and smaller shall have cross handle for operation by forked key. Enclose moving parts of valve and operator in housing to prevent contact with the soil.
 - b. Buried service operators to be grease packed and gasketed to withstand a submersion in water to 20 feet minimum.
 - c. Design buried service operators for quarter-turn valves to withstand 450-foot-pounds of input torque at the Fully Open or Fully Closed positions.
 - d. Buried valves shall have extension stems, bonnets, and valve boxes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flange Ends:

- 1. Flanged valve bolt holes shall straddle vertical centerline of pipe.
- 2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed Ends:

- 1. Clean threads by wire brushing or swabbing.
- 2. Apply joint compound.

C. Valve Installation and Orientation:

- 1. General:
 - a. Install valves so handles operate from fully open to fully closed without encountering obstructions.
 - b. Install valves in location for easy access for routine operation and maintenance.
 - c. Install valves per manufacturer's recommendations.
- 2. Gate, and Ball Valves:
 - a. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above finished floor, unless otherwise shown.

- b. Install operating stem horizontal in horizontal runs of pipe having centerline elevations greater than 4 feet 6 inches above finish floor, unless otherwise shown.
- 3. Butterfly Valves:
 - a. Unless otherwise restricted or shown on the Drawings, install valve a minimum of 8 diameters downstream of a horizontal elbow or branch tee with shaft in horizontal position.
 - b. For vertical elbow or branch tee immediately upstream of valve, install valve with shaft in vertical position.
 - c. For horizontal elbow or branch tee immediately upstream of valve, install valve with shaft in horizontal position.
 - d. When installed immediately downstream of a swing check, install valve with shaft perpendicular to swing check shaft.
 - e. For free inlet or discharge into basins and tanks, install valve with shaft in vertical position.

3.02 TESTS AND INSPECTION

- A. Valve may be either tested while testing pipelines, or as a separate step.
- B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions. Installation Contractor shall successfully cycle three times, manually and remotely, butterfly valves with electric motor actuators.
- C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.
- D. Count and record number of turns to open and close valve; account for any discrepancies with manufacturer's data.
- E. Set, verify, and record set pressures for relief and regulating valves.
- F. Each valve shall be tested for leakage both in factory and by installation contractor on project site during project startup. When shut, valves shall have zero leakage per API 598, except as follows. Resilient seated valves (including rubber seated ball valves, plunger valves and gate valves) shall have not visible leakage. All other valves shall have less than half the leakage API 598 allows (less than one drop per minute per inch diameter of valve).
- G. Installation Contractor shall test all pressure reducing valve functions and document flows and changes during three remote control changes of downstream pressure setting, and resultant valve opening or closing.

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3.03 MANUFACTURER'S SERVICES

- A. See Section 01 43 33, Manufacturers' Field Services, and Section 01 91 14, Equipment Testing and Facility Startup.

END OF SECTION

SECTION 44 42 56.10
HORIZONTAL END SUCTION CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. American Bearing Manufacturers' Association (ABMA).
 2. Hydraulic Institute Standards.
 3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.
 4. Occupational Safety and Health Administration (OSHA).
 5. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components - Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components - Lead Content.

1.02 DEFINITIONS

- A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.03 SUBMITTALS

- A. Action Submittals:
1. Shop Drawings:
 - a. Make, model, weight, and horsepower of each equipment assembly.
 - b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
 - c. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at guarantee point.
 - d. Detailed structural, mechanical, and electrical drawings showing equipment dimensions, size, and locations of connections and weights of associated equipment. Structural drawings shall include details for any required equipment anchorage and bracing.

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- e. Power and control wiring diagrams, including terminals and numbers.
- f. Complete motor nameplate data, as defined by NEMA, motor manufacturer.
- g. Factory finish system data sheets.

B. Informational Submittals:

- 1. Anchorage and bracing calculations by equipment manufacturer. Calculations shall be stamped by a registered Professional Engineer in the State of Utah. See Drawings for seismic structural design criteria.
- 2. Factory Functional Test Reports.
- 3. Manufacturer's Certificate of Compliance, in accordance with Owner's Requirements, that factory finish system is identical to the requirements specified herein.
- 4. Special shipping, storage and protection, and handling instructions.
- 5. Manufacturer's printed installation instructions.
- 6. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
- 7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
- 8. Operation and Maintenance Data: As specified by Owner.
- 9. Manufacturer's Certificate of Proper Installation, in accordance with Owner's requirements.

1.04 EXTRA MATERIALS

A. Furnish for this set of pumps:

- 1. Complete set gaskets and O-ring seals.
- 2. Complete mechanical seal.
- 3. One complete set of special tools required to dismantle pump.

PART 2 PRODUCTS

2.01 GENERAL

- A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.
- B. Furnish a coordinated operating system complete with pump, drive, and speed controller. See Section 26 24 19, Low Voltage Motor Control and Section 26 29 23, Low Voltage Adjustable Frequency Drive System.

- C. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 SUPPLEMENTS

- A. Some specific requirements are attached to this section as supplements.

2.03 ACCESSORIES

- A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.
- B. Lifting Lugs: Equipment weighing over 100 pounds.
- C. OSHA-approved coupling guard for direct coupled or belt driven pumps.
- D. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, 3/4-inch minimum diameter, and/or as specified on the Drawings.
- E. Coat entire baseplate assembly and anchor bolts in accordance with Section 09 90 00, Painting and Coating.

2.04 FACTORY FINISHING

- A. Prepare, and prime, and finish coat in accordance with Section 09 90 00, Painting and Coating.

2.05 SOURCE QUALITY CONTROL

- A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.
- B. Factory Tests and Adjustments: Test all equipment and control panels actually furnished.
- C. Factory Test Report: Include test data sheets, curve test results certified correct by a registered professional engineer in the state of Utah.

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D. Functional Test:

1. Perform manufacturer's standard, motor test on equipment. Include vibration test, as follows:
 - a. Dynamically balance rotating parts of each pump and its driving unit before final assembly.
 - b. Limits:
 - 1) Driving Unit Alone: Less than 80 percent of NEMA MG 1 limits.
 - 2) Complete Rotating Assembly Including Coupling, Drive Unit, and Motor: Less than 90 percent of limits established in the Hydraulic Institute Standards.

E. Performance Test:

1. In accordance with Hydraulic Institute Standards, Grade 2B.
2. Adjust, realign, or modify units and retest in accordance with Hydraulic Institute Standards if necessary.

F. Motor Test: See Section 26 20 00, Low-Voltage AC Induction Motors.

G. Hydrostatic Tests: Pump casing(s) tested at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4-inch per foot. Use double wedges to provide a level bearing surface for pump and driver base. Accomplish wedging so there is no change of level or springing of baseplate when anchor bolts are tightened.
- C. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.
- D. After pump and driver have been set in position, aligned, and shimmed to proper elevation, grout the space between the bottom of the baseplate and the concrete foundation with a poured, nonshrinking grout of the proper category, as specified on the Drawings. Remove wedges after grout is set and pack void with grout.

- E. Connect suction and discharge piping without imposing strain to pump flanges.
- F. Anchor Bolts: Accurately place using equipment templates and as specified on the Drawings.

3.02 FIELD FINISHING

- A. Finish equipment as specified in Section 09 90 00, Painting and Coating.

3.03 FIELD QUALITY CONTROL

- A. Functional Tests: Conduct on each pump.
 - 1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - 2. Vibration Test:
 - a. Test with unit installed and in normal operation, and discharging to the connected piping systems at rates between low discharge head and high discharge head conditions specified, and with actual building structures and foundations provided shall not develop vibration exceeding 80 percent of the limits specified in HIS 9.6.4.
 - b. If units exhibit vibration in excess of the limits specified, adjust or modify as necessary. Replace units which cannot be adjusted or modified to conform as specified.
 - 3. Flow Output: Measured by plant instrumentation and storage volumes.
- B. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.
- C. Performance Test:
 - 1. Conduct on each pump.
 - 2. Perform under simulated operating conditions.
 - 3. Test for a continuous 3-hour period without malfunction.
 - 4. Test Log: Record the following:
 - a. Total dynamic head.
 - b. Capacity.
 - c. Horsepower requirements.
 - d. Flow measured by plant instrumentation and storage volumes.
 - e. Average distance from suction well water surface to pump discharge centerline for duration of test.
 - f. Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.

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- g. Calculated velocity head at the discharge flange.
- h. Field head.
- i. Driving motor voltage and amperage measured for each phase.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative:

- 1. Present at Site or classroom designated by the Owner for minimum person-days listed below, travel time excluded:
 - a. 1 person-day for installation assistance and inspection.
 - b. 2 person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
 - c. 1/2 person-day for post-startup training of the Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by the Owner and the Engineer.

3.05 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification:
 - 1. Horizontal End Suction Centrifugal Pump No. 2, Pump No. 3 Data Sheet.

END OF SECTION

**HORIZONTAL END SUCTION CENTRIFUGAL
PUMP NO. 2, PUMP NO. 3 DATA SHEET**

Tag Numbers: P-102, P-103

Pump Name: Pump No. 2, Pump No. 3

Manufacturer and Model Number: (1) Grundfos KP 6015 3/4
(2) Pentair; 411-8x10x15b
(3) “Or Equal”

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Finished Water

Pumping Temperature (Fahrenheit): Normal: _____ Max _____ Min _____

Specific Gravity at 60 Degrees F: _____ Viscosity Range: _____

pH: _____

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Min. NPSH Available (Ft. Absolute): 131.2

Minimum NPSHA/NPSHR: 1.35

PERFORMANCE REQUIREMENTS AT PRIMARY DESIGN POINT

Capacity (US gpm): Rated: 3,500

Total Dynamic Head (Ft): Rated: 165

Min. Hydraulic Efficiency (%): 80

Maximum Shutoff Pressure (Ft): 250

Max. Pump Speed at Design Point (rpm): 1,800

Constant (Y/N): N Adjustable (Y/N): Y

PERFORMANCE REQUIREMENTS AT SECONDARY DESIGN POINTS

Capacity (US gpm): 2,000 _____ Capacity (US gpm): _____

Total Dynamic Head (Ft): 125 _____ Total Dynamic Head (Ft): _____

Min. Hydraulic Efficiency (%): 67 _____ Min. Hydraulic Efficiency (%): _____

DESIGN AND MATERIALS

ANSI (Y/N) _____ Standard (Y/N) _____ Design: Frame-mounted (Y/N) _____
Close-Coupled Casing (Y/N) _____ Back Pullout (Y/N) _____

Discharge Orientation: Horizontal _____ Rotation (view from end coupling): _____

Casing Materials: Cast Iron _____

Case Wear Ring (Y/N) _____ Material: _____

Impeller: Type: _____ Material: _____

Impeller Wear Ring (Y/N): _____ Material: _____

Shaft Material: _____ Shaft Sleeve Material: _____

Shaft Seal: _____ Packing (Y/N) N _____ Material: _____

Mechanical (Y/N) Y _____ Type: Split Mechanical Cartridge
Style _____

Lubrication: _____

ABMA L-10 Bearing Life (Hrs): _____ Lubrication: _____

Coupling: _____ Falk (Y/N) _____ Fast (Y/N) _____

Spring-Grid (Y/N) _____

Gear Type (Y/N) _____ Spacer (Y/N) _____ Manufacturer _____
Standard (Y/N) _____

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Baseplate: Design: _____ Material: Cast Iron

Drive Type: Direct-Coupled: _____ Belt _____ Adjustable Speed _____

Other: _____

Adjustable Speed Drive Range: 40-Hz min to 60-Hz max, See Section 26 29 23, Low Voltage Adjustable Frequency Drive System.

DRIVE MOTOR See Section 26 20 00, Low-Voltage AC Induction Motors.

Horsepower: 200 Voltage: 460 Phase: 3 Synchronous Speed (rpm): 1,800

Service Factor: 1.0 Inverter Duty (Y/N) Y _____

Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC X CISD-TEFC _____
TENV _____ WPI _____ WPII _____ SUBM _____

Mounting Type: Horizontal _____ Nonreverse Ratchet (Y/N) _____

REMARKS Motor to be rated for 4,561 FASL.

**DRAWINGS
(BOUND SEPARATELY)**
