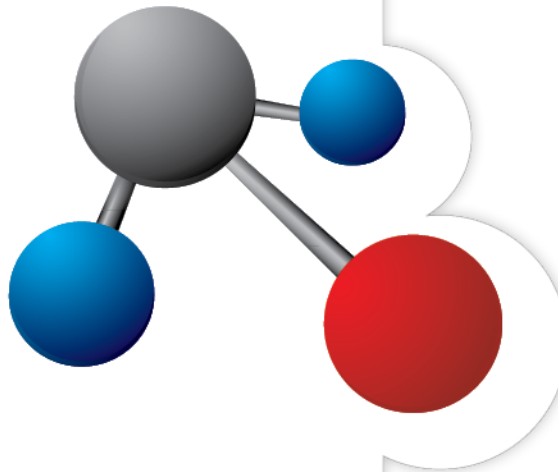


5700 West 10200 South Booster Pump Station Upgrades

South Jordan, Utah



Specifications
Divisions 00 to 46

PREPARED FOR:



JORDAN VALLEY WATER
CONSERVANCY DISTRICT

*Owner Project No. 4366
AE2S Project No. P11910-2024-001*

July 30, 2025

PROJECT MANUAL

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CONTRACT DOCUMENTS FOR THE
5700 West 10200 South Booster Pump Station Upgrades

PROJECT #: 4366
July 2025

BID DOCUMENTS & SPECIFICATIONS

OWNER

Jordan Valley Water Conservancy District
8215 South 1300 West
West Jordan, Utah
(801) 565-4300

ENGINEER

AE2S
3400 N Ashton Blvd, Ste 105
Lehi, UT 84043
(801) 331-8489

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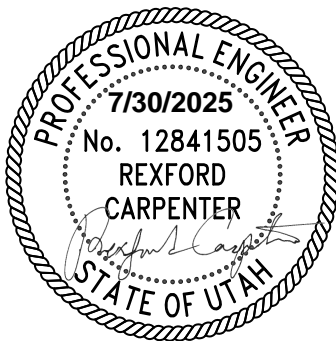
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END OF SECTION

**SPECIFICATIONS AND DOCUMENTS
FOR
5700 West 10200 South Booster Pump Station Upgrades
JORDAN VALLEY WATER CONSERVANCY DISTRICT**

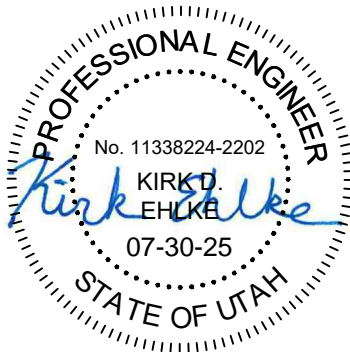
JULY 2025



CIVIL ENGINEER

Rexford Carpenter, PE
Advanced Engineering and Environmental Services, LLC

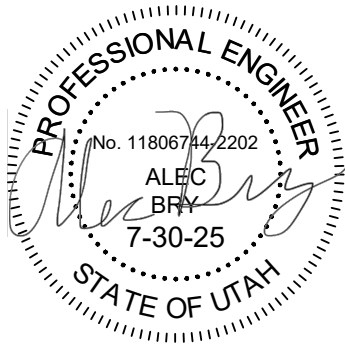
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am duly Registered Professional Engineer under the laws of the State of Utah.



STRUCTURAL ENGINEER

Kirk D. Ehlke, PE
Advanced Engineering and Environmental Services, LLC

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am duly Registered Professional Engineer under the laws of the State of Utah.

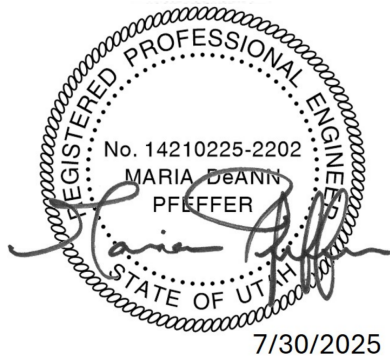


PROCESS ENGINEER

Alec Bry, PE

Advanced Engineering and Environmental Services, LLC

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am duly Registered Professional Engineer under the laws of the State of Utah.

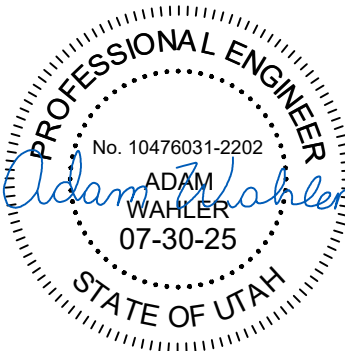


MECHANICAL ENGINEER

Maria D. Pfeffer, PE

KFI Engineers

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am duly Registered Professional Engineer under the laws of the State of Utah.



ELECTRICAL ENGINEER

Adam Wahler, PE

Advanced Engineering and Environmental Services, LLC

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am duly Registered Professional Engineer under the laws of the State of Utah.

DIVISION 00 BIDDING AND CONTRACT DOCUMENTS

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NOTICE INVITING BIDS

PROJECT NAME: 5700 West 10200 South Booster Pump Station Upgrades

DESCRIPTION OF WORK: The work comprises of pumping upgrades in the existing 5700 West 10200 South Booster Pump Station in South Jordan, Utah to increase the pumping capacity due to increasing demands. Improvements include the installation of two new 400 HP vertical turbine pumps, one 300 HP vertical turbine pump on VFD, new connections to the existing reservoir for the inlet, outlet, overflow and vent, electrical generator, automatic-transfer switch, modifications to existing electrical systems, restoration of the sites and facilities to its preconstruction condition, and performing all Work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents.

TANK WORK SPECIALTY CONTRACTOR QUALIFICATIONS: All work on the tank including the removal and reinstallation of inlet/outlet and overflow penetrations, vent, interior access ladder, drain scuppers, and interior and exterior repairs must be performed by a qualified tank contractor experienced with AWWA D-110 tank construction and repair.

Prospective bidders must include a separate qualification packet of five (5) pages with their bid. The required experience is listed in section 10 01 00 section 1.5 Quality assurance. In addition, the qualification packet must include 5 references associated with AWWA D110 tank rehabilitation, retrofit or repair projects.

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 website will be used to publish updated information relative to the project, including a plan holders list.

OBTAINING CONTRACT DOCUMENTS: The Contract Documents are entitled 5700 West 10200 South Booster Pump Station Upgrades. All Contract Documents may be obtained online at www.jvwcd.gov under "Engineering Projects"

SITE OF WORK:

1. 5700 West 10200 South, South Jordan, Utah, 84095

PRE-BID MEETING: A non-mandatory pre-bid meeting will be held at **2:00 pm, on Wednesday, September 3rd, 2025**, at the Site of the work (5700 West 10200 South, South Jordan, Utah, 84095). Prospective bidders with questions regarding the project are encouraged to attend to become familiar with the site and to ask any questions regarding the project.

NOTICE INVITING BIDS

RECEIPT OF BIDS: Sealed bids will be received at the 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, September 18th, 2025**, for construction of the 5700 West 10200 South Booster Pump Station Upgrades. Electronic bids may also be submitted in adobe .pdf format to ellisad@jvwcd.gov. **JVWCD suggests that electronic bids be submitted 15 minutes prior to the bid opening deadline, to allow for verification of delivery.** 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.

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

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.

COMPLETION OF WORK: All work shall be substantially completed by March 01, 2028. Work shall be sequenced and scheduled as listed Section 01 11 00 - Summary of Work.

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, 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.

NOTICE INVITING BIDS

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

AE2S

3400 N Ashton Blvd, Ste 105

Lehi, UT 84043

Telephone: (801) 331-8489

Contact: Sam Fankhauser, PE

Email: Sam.Fankhauser@AE2S.com

OWNER

Jordan Valley Water Conservancy District

8215 South 1300 West

West Jordan, Utah 84088

Telephone: (801) 565-4300

Project Manager: Conor Tyson, PE

Email: ConorT@jvwcd.gov

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.

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.

Specialty Tank Contractor qualification packets shall be included in the sealed packet with bids.

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 at the 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,

INSTRUCTIONS TO BIDDERS

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.

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

INSTRUCTIONS TO BIDDERS

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 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.

INSTRUCTIONS TO BIDDERS

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 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.

AWARD OF CONTRACT: Award of the Contract, if it be awarded, will be based primarily on the lowest overall cost to the Owner, and will be made to a responsive and responsible bidder whose bid complies with all the requirements prescribed. 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. Unless otherwise

INSTRUCTIONS TO BIDDERS

indicated, an award will not be made for less than all the bid items in an individual bidding schedule. In the event the entire work is contained in more than one bidding schedule, the Owner may award schedules individually or in combination. In the case of two bidding schedules which are alternate to each other, only one of such alternate schedules will be awarded.

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.

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 "5700 West 10200 South Booster Pump Station Upgrades" drawings and all addenda issued by said Owner prior to opening of the bids. The lowest bidder that is responsive and responsible will be selected. Owner reserves the right to award the base bid schedule only or both the base bid and the alternate bid schedules.

Addenda are only notified by e-mail and available to download through the internet.

The undersigned bidder acknowledges receipt of the following addenda:

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

Bidder agrees that, within 10 calendar days after receipt of Notice of Award from Owner, Bidder 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

Bid Schedule: 5700 West 10200 South Booster Pump Station Upgrades

Item No.	Description	Unit	Qty	Amount
1	Mobilization	1	LS	\$
2	Site Demolition & Improvements	1	LS	\$
3	Site Piping & Vaults	1	LS	\$
4	Reservoir Connection	1	LS	\$
5	Station Building Improvements	1	LS	\$
6	Pump Station Piping & Appurtenances	1	LS	\$
7	Pumps (incl. Motors)	1	LS	\$
8	HVAC	1	LS	\$
9	Electrical / I&C	1	LS	\$
10	NPDES Construction Stormwater Permit (Max Allowance)	1	LS	\$ 5,000.00
Bid Schedule Total:				\$

Total Project Bid Price including all system features shown or specified to make all project components complete and operable for the 5700 West 10200 South Booster Pump Station Upgrades Project in words:

_____ Dollars

and _____ Cents.

Bidder (Company name): _

By: _ Dated: _
(Signature)

Name: _ Title: _

BID

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 "5700 West 10200 South
Booster Pump Station Upgrades", (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: _____

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 B100 or 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 experience as a Construction Project Manager.
- Successfully served as Project Manager for one (1)

INFORMATION REQUIRED OF BIDDER

completed project that included the installation of pump and motor assemblies rated at 200 horsepower or greater.

- Successfully served as Project Manager for one (1) completed project that included the installation of electrical power generation equipment rated at 400 kilowatt or greater.
- **Note:** One project may satisfy multiple requirements.

Project Superintendent A: _____

Project Superintendent (Alternate 1): _____

Project Superintendent (Alternate 2): _____

Project Superintendent shall have:

- At least five (5) years construction Superintendent experience and ten (10) years total construction experience.
- Successfully completed one (2) projects as Project Superintendent that included the installation of pump and motor assemblies rated at 200 horsepower or greater.
- Successfully completed two (2) projects as project superintendent that included the installation of electrical power generation equipment rated at 400 kilowatt or greater.
- **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:

Contracting firm shall have successfully completed:

- Successfully completed two (2) projects that included the installation of pump and motor assemblies rated at 200 horsepower or greater.
- Two (2) projects that included the installation of electrical power generation equipment rated at 400 kilowatt or greater.

INFORMATION REQUIRED OF BIDDER

- One (1) project with a total value of at least \$1,000,000.

Note: One project may satisfy multiple requirements.

7. Name and title of officers of Contractor's firm:

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

Name: _____

Date of Inspection: _____

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 – provide experience that meets the requirements listed above)

Project Manager Data Sheet

Name: _____

Years experienced as Project Manager: _____

Years of construction experience: _____ Positions: _____

Qualifying Project #1 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #2 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT B

(Copy as necessary – provide experience that meets the requirements listed above)

Superintendent Data Sheet

Name: _____

Years experienced as Superintendent: _____

Years of construction experience: _____ Positions: _____

Qualifying Project #1 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #2 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

INFORMATION REQUIRED OF BIDDER

Qualifying Project #3 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #4 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT C

(Provide experience that meets the requirements listed above)

Contracting Firm Data Sheet

Name: _____

Qualifying Project #1 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #2 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #3 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

INFORMATION REQUIRED OF BIDDER

Qualifying Project #4 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

Qualifying Project #5 _____

Project Summary: _____

Pump and Motor Installed HP: _____ KW of Power Generation Installation: _____

Year Completed: _____

Total Cost: _____

Owner: _____

Owner Contact Person: _____ Telephone: _____

INFORMATION REQUIRED OF BIDDER

ATTACHMENT D

(Copy as necessary – provide experience that meets the requirements listed)

The contractor shall be a specialist tank contractor experienced in the design, construction, and rehabilitation of AWWA D-110 tanks, having rehabilitated, in their own name, at least 10 tanks in the last 10 years of equal size or greater, five (5) of which have been in successful service for a minimum of five (5) years, and shall have restored at least five (5) tanks with deteriorated concrete / shotcrete walls and or domes within the last five (5) years at least three (3) of which required the re-tensioning of and or replacement of damaged prestress wire. In addition, the specialist tank contractor shall have performed five (5) projects that include a pipe penetration on an AWWA D110 tank, through the wall, floor, or roof. Include 5 references.

Tank Sub-Contractor Data Sheet

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 _____, a _____ 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 _____. The Work is generally described 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 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 _____, a _____ 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 _____.
- 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 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 shall 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 final 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 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 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 ENGINEER as provided in the General Conditions.

- 5.1 Progress Payments: OWNER shall make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment

as recommended by ENGINEER, on a monthly basis. All progress payments will be on the basis of 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 final 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 moneys 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

In order 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 carefully all exploration reports and test 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 he had 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 _____, 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 this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraphs 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 22.

ARTICLE X
MISCELLANEOUS

- 10.1 Terms used in this Agreement which 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 for 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”:

Utah License No. _____

By: _____
Alan E. Packard
Its General Manager/CEO

By: _____
Its: _____

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 "5700 West 10200 South Booster Pump Station Upgrades".

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, "5700 West 10200 South Booster Pump Station Upgrades".

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:

Re: 5700 West 10200 South Booster Pump Station Upgrades

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: Conor Tyson.

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, PE
Chief Engineer

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:

Re: 5700 West 10200 South Booster Pump Station Upgrades

You are hereby notified to commence work in accordance with the Agreement dated _____, and you are to complete the work within ____ calendar days.

An acknowledged copy of this Notice to Proceed should be returned to the Owner, Attention: Conor Tyson, Staff 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: 5700 West 10200 South Booster Pump Station Upgrades

JVWCD PROJECT NO.: 4366

CONTRACTOR: _____

ADDRESS: _____

ENGINEER: _____

-
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 ____

NAME OF PROJECT: 5700 West 10200 South Booster Pump Station Upgrades

PROJECT NUMBER: 4366

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 – AE2S	Date
Accepted:	_____	_____
	Contractor -	Date
Approved:	_____	_____
	Owner - Jordan Valley Water Conservancy District	Date

JORDAN VALLEY WATER CONSERVANCY DISTRICT

**CONTRACTOR'S CERTIFICATE
OF
SUBSTANTIAL COMPLETION**

OWNER: Jordan Valley Water Con. District 8215 South 1300 West West Jordan, Utah 84088 801-565-4300	ENGINEER: AE2S 3400 N Ashton Blvd, Ste 105 Lehi, UT 84043 801-331-8489
---	---

PROJECT: 5700 West 10200 South Booster Pump Station Upgrades

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: Jordan Valley Water Con. District 8215 South 1300 West West Jordan, Utah 84088 801-565-4300	ENGINEER: AE2S 3400 N Ashton Blvd, Ste 105 Lehi, UT 84043 801-331-8489
---	---

PROJECT: 5700 West 10200 South Booster Pump Station Upgrades

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: 5700 West 10200 South Booster Pump Station Upgrades

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 "5700 West 10200 South Booster Pump Station Upgrades", 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

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 Contract 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.

GENERAL CONDITIONS

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.

GENERAL CONDITIONS

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.

GENERAL CONDITIONS

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.

GENERAL CONDITIONS

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.

GENERAL CONDITIONS

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.

GENERAL CONDITIONS

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

GENERAL CONDITIONS

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

GENERAL CONDITIONS

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.

GENERAL CONDITIONS

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

GENERAL CONDITIONS

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.

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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.

GENERAL CONDITIONS

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.

GENERAL CONDITIONS

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.

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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,

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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.

GENERAL CONDITIONS

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

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 AE2S
 3400 N Ashton Blvd, Ste 105
 Lehi, UT 84043
 (801) 331-8489

17.03 TESTING COSTS

1. Paragraph 13.03 of the General Conditions is amended as follows: the CONTRACTOR shall pay all testing costs. 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 \$500 for each calendar day's delay beyond the Contract Time for substantial completion. 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.

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 ten (10) 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.

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.

DIVISION 01 GENERAL REQUIREMENTS

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SECTION 01 11 00
SUMMARY OF WORK

PART 1 GENERAL

1.01 OVERVIEW

A. This section includes:

1. Project Description.
2. Project Work Covered by Contract Documents.
3. Contract Information.
4. Administrative and Procedural Sections.
5. Description of Work for All Construction.
6. Work by Owner.
7. Instrumentation and Control Responsibilities of Contractor and Work by Others.
8. Work Under Other Contracts.
9. Critical Work Sequences.
10. Access to Streets and Highways.
11. Reference Standards.
12. NPDES Construction Storm Water Permit.
13. Coordination of Existing Conditions and Contract Documents.
14. Salvaged Demolition Debris.
15. Restocking.
16. Excavation Stockpiling

1.02 PROJECT DESCRIPTION

Contract No. 1 - 5700 West 10200 South Booster Pump Station Upgrades

The Project generally consists of the following primary components:

1. The work comprises of pumping upgrades in the existing 5700 West 10200 South Booster Pump Station in South Jordan, Utah to increase the pumping capacity due to increasing demands. Improvements include the installation of two new 400 HP vertical turbine pumps, one 300 HP vertical turbine pump on VFD, new connections to the existing reservoir for the inlet, outlet, overflow and vent, electrical generator, automatic-transfer switch, modifications to existing electrical systems, restoration of

the sites and facilities to its preconstruction condition, and performing all Work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents.

1.03 PROJECT WORK COVERED BY CONTRACT DOCUMENTS

A. Work associated with the Project will be comprised of the following Contracts:

1. **Contract No. 1** – 5700 West 10200 South Booster Pump Station Upgrades

1.04 CONTRACT INFORMATION

- A. The Owner will award a single Prime Contract for which the Work will be completed under a lump sum contract for Contract No.1.
- B. The CONTRACTOR shall not commence work until proper execution of the contract and written authorization to proceed has been issued by the OWNER. Proper execution of the contract shall include all surety bonds and insurance requirements.
- C. The division of work as made by the specifications and contract drawings is for the purpose of specifying work which is required. There is no attempt to make classification according to trades or any agreements, which may exist between contractors or subcontractors and trade unions. Classification of the work shall be the CONTRACTOR'S responsibility.
- D. The location of work under these contract documents is located on property of the OWNER or easements obtained by the OWNER, as shown on the contract drawings.
- E. Completion Dates:
1. Substantial Completion - 03/01/2028.
 2. Final Completion - 04/15/2028
 3. Winter construction is required. CONTRACTOR shall include in their Bid all necessary requirements for sequencing and winter construction to meet the completion dates.
- F. Liquidation Damages for this project are as indicated in the Standard Contract between OWNER and CONTRACTOR.

G. Work of the Contract is identified in the following Articles.

1.05 ADMINISTRATIVE AND PROCEDURAL SECTIONS

A. Division 00 – Procurement and Contracting Requirements: All Sections.

B. Division 01 – General Requirements: All Sections.

1.06 DESCRIPTION OF WORK FOR ALL CONSTRUCTION

A. General: The following is provided to assist the Bidder in locating the major components and Work associated with the various bid items. It is not intended to provide a list of every drawing or specification that describes work associated with each bid item. In addition to the work shown or specified in the Specifications and Drawings listed below, Bidder shall include all work related to each bid item in the bidder's price for each bid item including, but not limited to, Division 00, Division 01, Civil, Structural, Process, Mechanical, Electrical, and I&C.

1. Base Bid:

- a. Specifications: All Divisions and Sections:
- b. Drawings: All Drawings.

1.07 WORK BY OWNER

A. Contractor shall coordinate the timing and operational requirements of the Work with the Owner and Engineer.

B. Owner will provide control system programming for the Project. Contractor shall coordinate control system Work with Engineer and allow ample time for completion of required control system, check-out, programming, and start-up and training services to meet Contractor's Substantial and Final Completion dates.

C. Decommissioning of process units, tanks, equipment or systems as required by the Contractor for the purposes of completing the Work. Decommissioning is limited to taking the unit, tank, item of equipment or system out of service. The Contractor is responsible for disconnecting piping, power, utilities, and controls; for demolition; for temporary valves, barriers, piping, barricades, and other temporary facilities; and all other Work.

D. For all piping systems, unless otherwise specified herein, the Owner will drain the lines.

- E. Initial filling of process units, tanks, or systems for the purpose of testing except as otherwise specified.
- F. Filling of process units, tanks or systems for the purpose of placing them into service.
- G. Operation of existing facilities not taken out of service or otherwise made available to the Contractor for purposes of executing the Work.

1.08 INSTRUMENTATION AND CONTROL RESPONSIBILITIES OF CONTRACTOR AND WORK BY OTHERS

- A. The following Work is considered the responsibility of the Contractor:
 - 1. Contractor shall provide and electrically install all instrumentation devices. If any devices fail to operate correctly, it will be the Contractor's responsibility to repair or replace the device or otherwise correct the deficiencies, including any additional supplier setup, calibration, or on-site services related to each defective device.
 - 2. Contractor shall provide Owner with assistance during the instrumentation and control device check out. Check out is to occur upon completion of installation of the devices.
 - 3. Contractor shall furnish and install all cable and connectors for control system communications network and computer network.
 - 4. Contractor shall furnish original equipment documentation for each component of the control system provided.
 - 5. Contractor shall furnish to the instrumentation manufacturer all information required for factory calibration and scaling.
 - 6. Contractor shall certify the integrity of all communication cables prior to termination in the control panel.
 - 7. Contractor shall provide training to Owner regarding operation and maintenance of instrumentation devices.
 - 8. Assembly of Product documentation provided by the Contractor, functional control descriptions, and operational instructions for incorporation into Contractor's O&M Manuals.
 - 9. Contractor shall be responsible for the warranty for all equipment provided and installed by the Contractor.
 - 10. Contractor shall verify that all equipment operates properly in a manual mode, before Owner attempts to place into automatic operation.

B. The following Work is by Others:

1. Installation of utility transformer.
2. Utility connection of transformer to utility power.

1.09 WORK UNDER OTHER CONTRACTS

Include a description of any work under other contracts below Part A:

A. The Owner may award additional contracts which may affect operation of the Contractor. The Contractor for this Project will be required to coordinate construction sequencing with other contracts. As part of the (Define project type), the following Work will be completed under other contracts:

1.10 CRITICAL WORK SEQUENCES

- A. Coordinate construction schedule and operations with Owner and Engineer to accommodate Owner occupancy requirements.
- B. The Contractor must work with Owner and Engineer to ensure the uninterrupted supply of drinking water throughout the duration of the Project.
- C. Sequencing of the Work shall be the responsibility of the Contractor with input from all subcontractors.
- D. Contractor shall provide Owner and Engineer full access to existing facilities for the duration of the project.
- E. Critical Work Sequences:
 1. Storage Reservoir Shutdowns:
 - a. Reservoir shutdown, draining, and construction of improvements shall occur between the dates of November 1, 2026 through March 1, 2027. All shutdowns must be scheduled with JWWCD operators.
 - b. The storage reservoir shall only be offline for 30 calendar days or less.
 - c. Prior to reservoir shutdown(s), reservoir shall be isolated from JWWCD system using existing isolation valves by JWWCD operators.
 - d. All reservoir improvements, including all new tank penetrations, new inlet/outlet piping installation, new overflow inlet structure and piping installation, vent replacement, roof improvements, and

- demolition of existing reservoir piping shall take place during scheduled reservoir shutdown periods.
- e. Installation of the new tank overflow discharge structure may take place prior to the reservoir shutdown period with written permission from owner.
2. Pump Station Shutdowns:
- a. Electrical shutdowns to pump station shall occur between the dates of November 1, 2027 through March 1, 2028. All shutdowns must be scheduled with JVVCD operators.
 - b. Unless written permission is provided from owner, all pump station improvement work shall be completed within the 2027-2028 shutdown period.
 - c. Prior to electrical shutdown(s), pump station shall be isolated from JVVCD system using existing isolation valves by JVVCD operators.
 - d. All improvements to pump station, including all electrical work, new pump installation, process piping installation, and demolition of existing pump station piping and equipment shall take place during scheduled pump station shutdown periods.
 - e. All modifications to existing site piping, valves, and structures on the South side of the pump station shall take place during scheduled pump station shutdown periods. Excavation and backfill for site piping work may take place outside of pump station shutdown period with written permission from owner.
 - f. Structural improvements to the pump station roof, floor coating removal and replacement, installation of concrete pad and wall bracing for new permanent generator, installation of concrete pier for new AC unit, and some HVAC improvements to pump station may take place outside of pump station shutdown period with written permission from owner.

1.11 ACCESS TO STREETS AND HIGHWAYS

- A. Maintain suitable means of access for property owners abutting streets and highways involved in construction, except as specifically permitted otherwise by Owner.
- B. The Contractor shall be responsible for all construction signing, flagging, and protection of the public. Signing shall conform to requirements as set forth in the Manual on Uniform Traffic Control devices.

- C. Whenever construction is stopped due to inclement weather, weekends, holidays, or other reasons, suitable access shall be provided for all property owners.
- D. Maintain access for firefighting equipment and access to fire hydrants.

1.12 REFERENCE STANDARDS

- A. For products specified by association or trade standards, comply with requirements of the standard, except when requirements that are more rigid are specified or are required by applicable codes.
- B. Obtain copies of standards when required by contract documents. Maintain copy at job site during progress of the specific Work.

1.13 NPDES CONSTRUCTION STORM WATER PERMIT

- A. The Project consists of disturbing more than one (1) acre of area and will require an NPDES/SDS Construction Storm Water Permit.
- B. Following award of the contract the Owner will prepare the NPDES/SDS Construction Storm-water Permit Application for the Project to be signed and submitted jointly by the Owner and Contractor.
- C. Contractor shall be responsible for all provisions required in the NPDES Construction Storm Water Permit for the Project including the storm water pollution prevention plan (SWPPP) that is required to be submitted with the permit and all comments received by the Minnesota Pollution Control Agency (MPCA) regarding the permit and SWPPP for approval.
- D. Contractor to pay permitting fees with an maximum allowance of \$5,000.
- E. See Section 01 50 00 for additional requirements.

1.14 COORDINATION OF EXISTING CONDITIONS AND CONTRACT DOCUMENTS

- A. Data on subsurface conditions are made available for convenience of CONTRACTOR and are not intended as representations or warranties of accuracy or continuity between soil borings.
- B. It is expressly understood that the OWNER will not be responsible for interpretations or conclusions drawn by CONTRACTOR from subsurface

data. Additional subsurface data gathering operations may be made by CONTRACTOR. Contact OWNER for site access for additional test borings and/or other exploratory operations which may be made by CONTRACTOR at no cost to OWNER.

- C. Do not interrupt existing utilities except when permitted in writing by ENGINEER and then only after acceptable temporary utility services have been provided.
- D. Take and verify dimensions of existing structures, piping, and equipment required for the proper fabrication and installation of new piping and equipment.
- E. The Drawings indicate required pipe sizes and the general arrangement for major piping and equipment. Layout and arrangement for certain other piping systems shall be in conformance to the equipment items furnished. Locations shall be verified in the field by the CONTRACTOR. Valves and fittings furnished shall be of such dimensions to allow for the installation of this piping as shown on the Drawings. In the event it should become necessary to change the location of the work due to interference with other work, the CONTRACTOR shall request written permission from the ENGINEER before making changes, and such changes shall be made without added cost to OWNER. Under no circumstances shall the pipe sizes indicated on the Drawings be changed without first having the written approval of the ENGINEER.
- F. The final length and location of required pipe connections to equipment shall be coordinated to meet the requirements and recommendations of the equipment manufacturer and shall be subject to the approval of the ENGINEER.
- G. Install no work that directly connects to equipment until such time as complete shop drawings of said equipment have been reviewed and approved by the ENGINEER.

1.15 SALVAGED DEMOLITION DEBRIS

- A. OWNER shall have the right to retain select demolition debris. At the discretion of OWNER, select demolition debris items shall be stored on-site and remain the property of the OWNER. OWNER shall designate the location for storage of salvageable demolition debris items. CONTRACTOR shall place selected items in designated storage area.

1.16 RESTOCKING

- A. There will be no additional compensation made to CONTRACTOR due to restocking charges for materials not used on the project.

1.17 EXCAVATION STOCKPILING

- A. All excess excavated material on site shall be disposed of by Contractor. Storage of excavated material shall be coordinated by the Contractor as the construction site has limited storage space.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

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SECTION 01 14 00
WORK RESTRICTIONS

PART 1 **GENERAL**

1.01 SUMMARY

- A. This Section includes:
 - 1. Special Provisions.
 - 2. CONTRACTOR Use of Site and Premises.
 - 3. Owner Occupancy Requirements.
 - 4. Road Restrictions.

1.02 SPECIAL PROVISIONS

- A. In addition to the liquidated damages as stated in Section F – Agreement, CONTRACTOR will also be responsible for payment of any legitimate claims made by other parties (i.e., other CONTRACTORS, residents, etc.) within the area who have incurred a loss as a result of CONTRACTOR's construction practices or failure to complete the Work of this project by the specified completion date(s).
- B. CONTRACTOR will not be entitled to any compensation for causes resulting in delays or hindrances to the Work. Extensions of time will be granted for unavoidable delays, which in the opinion of the Engineer are clearly beyond the control of the CONTRACTOR. Unavoidable delays include, but are not limited to, acts of God or the public enemy, acts of the Owner, fires, floods, epidemics, quarantine restrictions, strikes, and freight embargos. The Engineer must receive written request for time extension from the CONTRACTOR not more than 10 days after commencement of delay before any time extension will be considered. Requests made beyond the 10-day limit will be cause for denial. Any extension of time will not relieve the CONTRACTOR or CONTRACTOR's sureties from their obligations, which shall remain in full force and effect until the satisfactory discharge of the Contract.
- C. It shall be the CONTRACTOR's responsibility to follow OSHA standards for all Work.
- D. All incidental damages to streets, driveways, berms, etc. due to CONTRACTOR's construction techniques shall be repaired at the CONTRACTOR's expense prior to making final payment.
- E. No open trenching across intersections will be allowed without prior approval. Existing streets and intersections shall be cleaned to the condition that existed prior to the start of construction.

- F. Traffic signs affected by construction activity shall be removed, stored, and replaced by CONTRACTOR. Temporary replacement signs shall be erected as required. Damage or lost signs as a result of the Project shall be replaced by the CONTRACTOR and the replacement cost shall be considered incidental to the Contract.
- G. CONTRACTOR shall comply with ordinances of the City of South Jordan concerning truck traffic within the City and designated haul routes. It is the CONTRACTOR's responsibility to obtain a copy of and comply with all of the ordinances. Copies of City ordinances may be obtained at the South Jordan City Hall.
- H. CONTRACTOR shall obtain such permits and licenses that are required for completion of the Work. Refer to Supplemental General Conditions for additional permit requirements. Permits include, but are not limited to;
 - 1. National Pollutant Discharge Elimination System (NPDES) Storm Water Permit.
 - 2. Permit and/or coordination with the State Electrical Inspector, as required.
 - 3. Building Permit from the City of South Jordan.
 - 4. Mechanical Permit from the City of South Jordan.
 - 5. Plumbing Permit from the City of South Jordan.
 - 6. General, Mechanical and Plumbing Contractor must be licensed in the City of South Jordan. License fee is not refundable by the City.
 - 7. Other Permits as required for completion of the Work.

1.03 CONTRACTOR USE OF SITE AND PREMISES

- A. Limit use of Site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Others.
- B. Coordinate performance of all Work with Owner operations.
- C. Coordinate use of premises under direction of Engineer. CONTRACTOR shall confine construction equipment, storage of materials and equipment and operations of workmen to areas permitted by law, ordinances, permits, or requirements of Contract Documents, and shall not unreasonably encumber premises with construction equipment or other materials or equipment.
- D. Assume full responsibility for the protection and safekeeping of products under this Contract, stored on the site.
- E. Move any stored products, under CONTRACTOR's control, which interfere with operations of the Owner.

- F. Construction personnel may park only in areas designated by the OWNER.
- G. Obtain and pay for use of storage or work areas needed for operations.
- H. CONTRACTOR, in coordination with Owner, shall notify and coordinate with Police Department, Fire Department, and Hospital/Ambulance Services. Notice shall include work schedule as construction proceeds, when work affects or obstructs intersections and streets, and when work is completed or suitable access is available in streets and intersections.
- I. CONTRACTOR shall provide the name, address, and telephone number of person who has access to equipment and is authorized to make emergency repairs to CONTRACTOR's work, such as to correct trench cave-ins, move excavated material, and correct other problems during weekends and off-work hours, so access can be maintained for firefighting equipment, and to maintain barricades for public safety.
- J. The CONTRACTOR must be satisfied through personal examination of the Site(s) as to all local conditions affecting their performance of the Contract. The CONTRACTOR is deemed to accept such conditions as found to exist.
- K. The CONTRACTOR shall preserve all monuments, benchmarks, reference points, and stakes. In case of destruction thereof, the CONTRACTOR will be charged with expense of replacement and shall be responsible for any mistake or loss of time that may be caused. Permanent monuments or benchmarks which must be removed or disturbed shall be protected until properly referenced for relocation. The CONTRACTOR shall furnish materials and assistance for the proper replacement of such monuments or benchmarks.
- L. Damaged Property:
 - 1. Patch and or clean existing improvements and restore damage of property on, or adjacent to the Site(s) occasioned by the Work, including but not limited to, lawns, walks, driveways, roadways, curbs, pavements, structures, and utilities which are cut or damaged by operations and are not designated for removal, relocation, or replacement in the course of construction.
 - 2. If any direct or indirect damage is done to public or private property resulting from any act, omission, neglect, or misconduct, the CONTRACTOR shall restore the damaged property to a condition equal to that existing before the damage at no additional cost to the OWNER. Repair, rebuild, or restore property as directed or make good such damage in an acceptable manner.
 - 3. Provide written acceptance of restoration by authority or OWNER.

M. Existing Facilities:

1. The CONTRACTOR shall take all necessary field measurements affecting all existing construction, wiring, piping, and equipment in this Contract and shall be solely responsible for proper fit between all Work under the Contract and existing structures, piping, and equipment.
2. Dimensions given on the drawings related to existing structures are based upon existing construction record drawings and it shall be the responsibility of the CONTRACTOR to verify the accuracy of all dimensions shown for existing structures, piping, and equipment. Any discrepancies shall be brought to the attention of the ENGINEER prior to the start of new construction or ordering of any materials.
CONTRACTOR shall be responsible for any materials ordered that will not fit due to the failure to verify any discrepancies of existing structures, piping, and equipment prior to the start of new construction.

N. Existing Utilities:

1. Existing underground utilities, as shown on the drawings, are located in accordance with available data but locations shall be determined by the CONTRACTOR prior to beginning construction. A utility locate is required prior to any excavation.
2. CONTRACTOR shall protect all existing utilities and provide temporary removal and replacement or relocation as required for completion of the Work in the contract documents. No additional payment shall be made for this work.
3. Existing utilities not shown on the drawings and requiring relocation shall be exposed by the CONTRACTOR without damage. If damaged, the CONTRACTOR shall bear the responsibility and cost of repair or replacement.

O. Environmental Resources:

1. Protect environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire period of this Contract. Confine activities to areas defined by the contract documents.
2. Prior to construction, identify all land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, top soil, and land forms without permission from the OWNER. Do not fasten or attach ropes, cables, or guys to trees for anchorage unless specifically authorized, or where special emergency use is permitted.

3. Protect trees, shrubs, vines, grasses, land forms, and other landscape features shown on the drawings to be preserved by marking, fencing, or using other approved techniques.
4. The erosion and sediment controls selected and maintained by the CONTRACTOR shall be such that water quality standards are not violated as a result of the CONTRACTOR'S activities. Maintain temporary erosion and sediment control measures such as fencing, berms, dikes, drains, sedimentation basins, grassing, and mulching, until permanent drainage and erosion control facilities are completed and operative.
5. See Contract Documents for additional requirements.

1.04 OWNER OCCUPANCY REQUIREMENTS

- A. Cooperate with Owner to minimize conflict and to facilitate Owner's operations. Schedule all Work to accommodate this requirement. No interruption will be permitted which adversely affects the degree of service the Owner provides. CONTRACTOR shall provide temporary facilities and make temporary modifications as necessary to keep the facilities in operation during the construction period.
- B. Pre-plan, schedule, coordinate, and stage for required materials, manpower, CONTRACTORS, subcontractors, etc. to complete critical elements of Work.
- C. Existing materials and equipment removed and not reused as part of the Work, and not identified elsewhere in the contract documents for salvage, shall be properly disposed of by the CONTRACTOR at no additional cost to Owner.
- D. Owner must approve all proposed water infrastructure shut-downs. CONTRACTOR to schedule 48 hours in advance of anticipated shutdown. Owner may deny schedule if anticipated daily production requirements or other considerations cannot be met during normal operating hours.

1.05 ROAD RESTRICTIONS

- A. CONTRACTOR shall take road restrictions into consideration. Road restrictions shall not be used as an excuse for missing deadlines and CONTRACTOR shall take road restrictions into consideration in preparing their lump sum bid price.

PART 2 PRODUCTS

2.01 NOT USED.

PART 3 EXECUTION

3.01 NOT USED.

END OF SECTION

SECTION 01 21 00
ALLOWANCES

PART 1 **GENERAL**

1.01 SUMMARY

A. This Section includes:

1. Cash Allowances.

B. Related Sections include:

1. Section 01 29 76 – Progress Payment Procedures.
2. Section 01 31 13 – Project Coordination.
3. Section 01 33 00 – Submittal Procedures.
4. Section 01 77 00 – Closeout Procedures.

1.02 CASH ALLOWANCES

A. Submit:

1. Proposals for purchase of products or systems included in allowance.
2. Invoices or delivery slips to show actual prices and quantities of materials delivered to the site for use in fulfillment of each allowance.
3. Refer to Section 01 33 00 – Submittal Procedures.

B. The Contractor shall include in their in their Contract Price a sum they deem appropriate for overhead and profit for administration and handling of the Allowance(s). Refer to Article 11 of the General Conditions.

C. The following cash allowances have been established for Contract No. 1 - General Construction under the Base Bid:

Include any relevant items or features as required:

1. NPDES Stormwater Permit Fees:
 - a. An Allowance up to \$5,000 for the purchase of NPDES stormwater permitting. payment will be made to contractor based upon actual fees. Contractor is not required to determine permit fees for bid.

D. Any monetary sum provided by the Cash Allowances established in Part 1, Item 1.03.B of this Section and not submitted for reimbursement by the Owner shall be deducted from the Final Payment.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 **GENERAL**

1.01 SUMMARY

A. Section includes:

1. Submittals.
2. Documentation of Change in Contract Price and Contract Time.
3. Change Procedures.
4. Work Change Directive.
5. Stipulated Price Change Order.
6. Time and Material Change Order.
7. Execution of Change Orders.
8. Correlation of Contractor Submittals.

B. Related Sections include:

1. Section F-P – Contract Agreements.
2. Section 01 29 76 – Progress Payment Procedures.
3. Section 01 33 00 – Submittal Procedures.
4. Section 01 61 00 – Common Product Requirements.
5. Section 01 77 00 – Closeout Procedures.

1.02 SUBMITTALS

- A. Submit name of the individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Change Order Forms: Form L-1 of Contract Documents

1.03 DOCUMENTATION OF CHANGE IN CONTRACT PRICE AND CONTRACT TIME

- A. Maintain detailed records of work done on a time and material basis. Provide full information required for evaluation of proposed changes, and to substantiate costs of changes in the Work.
- B. Document each quotation for a change in cost or time with sufficient data to allow evaluation of the quotation.
- C. Provide additional data to support computations:
1. Quantities of products, labor, and equipment.
 2. Taxes, insurance, and bonds.

3. Overhead and profit (in accordance with provisions of General Conditions).
 4. Justification for any change in Contract Time.
 5. Credit for deletions from Contract, similarly documented.
- D. Support each claim for additional costs, and for work done on a time and material basis, with additional information:
1. Origin and date of claim.
 2. Dates and times work was performed, and by whom.
 3. Time records and wage rates paid.
 4. Invoices and receipts for products, equipment, and subcontracts, similarly documented.

1.04 CHANGE PROCEDURES

- A. The Engineer will advise of minor changes in the Work not involving an adjustment to Contract Price or Contract Time by issuing supplemental instructions.
- B. The Engineer may issue a Proposal Request that includes a detailed description of a proposed change with supplementary or revised Drawings and specifications and a change in Contract Time for executing the change. Contractor will prepare and submit an estimate within five (5) days.
- C. The Contractor may propose a change by submitting a request for change to the Engineer, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Price and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors.

1.05 WORK CHANGE DIRECTIVE

- A. Engineer may issue a document, signed by the Owner, instructing the Contractor to proceed with a change in the Work, which may require subsequent inclusion in a Change Order if any change in Contract Price or Contract Time is required.
- B. The document will describe changes in the Work, and will designate method of determining any change in Contract Price or Contract Time. A work change directive will not include any change in Contract Price or Contract Time without written notice and approval by the Engineer for inclusion in a Change Order.
- C. Promptly execute the change in Work.

1.06 STIPULATED PRICE CHANGE ORDER

- A. Based on Proposal Request and Contractor's fixed price quotation or Contractor's request for a Change Order as approved by Engineer.

1.07 TIME AND MATERIAL CHANGE ORDER

- A. Submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- B. Engineer will determine the change allowable in Contract Price and Contract Time as provided in the Contract Documents.
- C. Maintain detailed records of work done on Time and Material basis.
- D. Provide full information required for evaluation of proposed changes, and to substantiate costs for changes in the Work.

1.08 EXECUTION OF CHANGE ORDERS

- A. Execution of Change Orders: Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract. The form to be used shall be that indicated in Paragraph 1.02.B of this Section. Engineer will then present the proposed signed Change Order to Owner for approval. Upon obtaining approval, the Change Order will be submitted to the Owner for signatures as provided in Conditions of Contract.

1.09 CORRELATION OF CONTRACTOR SUBMITTALS

- A. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Price.
- B. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- C. Promptly enter changes in Project Record Documents.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 01 29 27
MEASUREMENT AND PAYMENT

PART 1 **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Measurement and payment criteria applicable to the Work.
2. Defect assessment and non payment for rejected Work.

B. Related Sections

1. Section C – Bid Form.
2. Section F – Agreement.
3. General Conditions.
4. Supplemental General Conditions.
5. Section 01 11 00 – Summary of Work.
6. Section 01 29 00 – Payment Procedures.

1.02 AUTHORITY

- A. The Engineer and Owner will make final determinations regarding the completeness of Work, and subsequent payment of such Work.
- B. The Engineer and Owner will take all measurements and compute quantities accordingly.
- C. Contractor shall assist by providing necessary measurements, supporting data, and field data as required.

1.03 BID ITEMS

- A. No other items of Work required by the Drawings or Specifications shall be measured or paid for separately, but shall be included as part of the listed item to which the Work pertains. Failure to list all such related Work in the following descriptions of items shall not invalidate this stipulation nor relieve the Contractor from his obligation for such Work.
 1. Mobilization (Item No. 1): See 1.08 of this Section.
 2. Site Demolition & Improvements (Item No. 2): Includes all labor, materials, equipment, and supplies to remove existing asphalt, gravel, curb, grass, soil, etc. as shown in the Drawings. Also includes all labor, materials, equipment, and supplies to perform all site grading and install

new concrete and asphalt pavement, all concrete pads, etc., as shown in the Drawings.

3. Site Piping & Vaults (Item No. 3): Includes all labor, materials, equipment, and supplies to install and commission all steel and ductile water piping and appurtenances, butterfly valve vaults with associated equipment, check valve retrofit into existing vault, cathodic protection stations and associated equipment, and drain line piping and appurtenances as shown in the Drawings.
4. Reservoir Connection (Item No. 4): Includes all labor, materials, equipment, and supplies to refurbish the necessary repairs, and retrofit and commission a new connection, overflow, and vent into the existing 3 MG reservoir as shown in the Drawings.
5. Station Building Improvements (Item No. 5): Includes all labor, materials, equipment, and supplies to install a new steel roofing membrane with access hatches, and gutters as shown in the Drawings.
6. Pump Station Piping & Appurtenances (Item No. 6): Includes all labor, materials, equipment, and supplies to install and commission all steel process piping with associated appurtenances, including pipe supports, valves, couplings, pressure gauges, expansion joints, and flow meter as shown in the Drawings.
7. Pumps (incl. Motors) (Item No. 7): Includes all labor, materials, equipment, and supplies to install and commission three vertical turbine pumps with their associated motors and appurtenances as shown in the Drawings.
8. HVAC (Item No. 8): Includes all labor, materials, equipment, and supplies to install and commission gas unit heaters with associated equipment, dehumidifiers, and all split system components including two condensing units, two air handling units, refrigerant lines, and ductwork.
9. Electrical / I&C (Item No. 9): Includes all labor, materials, equipment, and supplies to remove and replace or install and commission all electrical service components including switchgear, ATS, transformer, and electrical duct bank with associated cabling, all facility electrical components including transformers, MCC, and panelboards with associated cabling and equipment terminations, grounding, lighting, back-up power generator, and all instrumentation and network circuiting including fiber optic cabling as shown in the Drawings.
10. NPDES Construction Stormwater Permit (Max Allowance) (Item No. 10): Includes the fee associated with NPDES construction stormwater permitting fees set at a maximum allowance of \$5,000.

1.04 PAYMENT

- A. Payment includes: Full compensation for all required mobilization, bonding, insurance, labor, skill, products, tools, equipment, rentals, transportation,

services, incidentals, erection, application and installation of the Work; submittal of Shop Drawings, product data and operation and maintenance data or manuals, record data, start-up and system demonstration, where required, warranties, overhead and profit.

- B. Final Payment for Work will be made on the basis of the Work accepted by the Engineer and Owner.

1.05 EXCAVATION AND TRENCHING

- A. No separate payment shall be made for excavation or trenching.

1.06 DEFECT ASSESSMENT

- A. Replace the Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of the Engineer, it is not practical to remove and replace the Work, the Engineer will direct one of the following remedies:
 - 1. The defective Work may remain, but the price will be adjusted to a new price at the discretion of the Engineer and Owner.
 - 2. The defective Work will be partially repaired to the satisfaction of the Engineer and Owner, and the price will be adjusted at the discretion of the Engineer and Owner.
- C. The authority of the Engineer and Owner to assess the defect and determine payment adjustment is final.

1.07 NON-PAYMENT FOR REJECTED PRODUCTS

- A. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected Products.

1.08 SCHEDULE OF PRICES

- A. Bonding:
 - 1. This item shall consist of all bonding and insurance for all Work included within the Construction Contract. The bonding and insurance shall be limited to five percent (5%) of the total Contract Bid Price.

B. Mobilization:

1. This item shall consist of all Work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to and from the Project Site; for the establishment and subsequent removal of all offices and storage facilities, Contractor's buildings, and other facilities necessary for Work on the project; and for all licenses, fees, and permits; and for all other Work and operations which must be performed, or costs incurred, prior to beginning and after completion of Work on the various items on the Project Site.
2. When partial payments are made on the contract, payment for mobilization will be made according to the following schedule:
 - a. When 5 percent of the original contract amount is earned, 25 percent of the amount bid for mobilization, or 2-½ percent of the original contract amount, whichever is less, will be paid.
 - b. When 10 percent of the original contract amount is earned, 50 percent of the amount bid for mobilization, or 5 percent of the original contract amount, whichever is less, will be paid.
 - c. When 25 percent of the original contract amount is earned, 60 percent of the amount bid for mobilization, or 6 percent of the original contract amount, whichever is less, will be paid.
 - d. When 65 percent of the original contract amount is earned, 90 percent of the amount bid for mobilization, or 9 percent of the original contract amount, whichever is less, will be paid.
 - e. When 80 percent of the original contract amount is earned, 100 percent of the amount bid for mobilization, or 10 percent of the original contract amount, whichever is less, will be paid.
3. Upon completion of all Work on the Project, payment of any amount bid for mobilization in excess of 10 percent of the total contract amount will be paid.

1.09 CHANGES IN PLAN QUANTITY

- A. Plan quantities are based on assumed existing conditions and/or as stated in payment sections or notes. An increase or decrease from the number of units shown in the Bid Form shall not cause a change in the unit price except as allowed by the General Conditions.

1.10 INCIDENTAL ITEMS

- A. Work required by the Contract Documents but not listed as a bid item shall be considered incidental to the Contract.
- B. Clean-up and restoration of all Work areas, storage areas, and traffic and haul routes shall be considered incidental to the Contract, and shall be performed as required by the Contract Documents or as directed by the Engineer.

- C. Repair of new and existing surfaces or features damaged by Contractor's Work operations shall be performed incidental to the Contract, and shall consist of restoration in-kind to the satisfaction of the Engineer.

PART 2 **PRODUCTS**

2.01 NOT USED.

PART 3 **EXECUTION**

3.01 NOT USED.

END OF SECTION

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SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

PART 1 **GENERAL**

1.01 SUMMARY

A. Section includes:

1. Format and Preparation of Applications.
2. Submittal Procedures.
3. Substantiating Data.

B. Related Sections include:

1. Section F-1 – Agreement.
2. General Conditions.
3. Section 01 23 00 – Contract Considerations and Alternates.
4. Section 01 26 00 – Contract Modification Procedures.
5. Section 01 29 76 – Progress Payment Procedures.
6. Section 01 33 00 – Submittal Procedures.
7. Section 01 77 00 – Closeout Procedures.

1.02 FORMAT AND PREPARATION OF APPLICATIONS

A. Utilize: Engineers Joint Contract Document Committee (EJCDC) Application for Payment Form (C-620, 2018 Edition).

B. Preparation

1. Present required information in typewritten form.
2. Execute certification by signature of authorized officer.
3. List each authorized Change Order as an extension on Continuation Sheet, listing Change Order number and dollar amount as for an original item of Work.
4. Prepare Application for Final Payment as specified in Section 01 77 00.

1.03 SUBMITTAL PROCEDURES

A. Submittals

1. Three (3) copies or one (1) Digital copy of each Application for Payment.
2. Updated construction schedule with each Application for Payment.
3. Payment Periods: As stipulated in the Agreement.
4. Submit with transmittal letter as specified for Submittals in Section 01 33 00.

5. Administrative actions which must precede or coincide with submittal of final application for payment include:
 - a. Submit lien waivers, warranties and bonds, and project record documents with final application for payment.
 - b. Completion of all work not included in substantial completion as defined in General and Supplementary Conditions.
 - c. Completion of project closeout procedures as indicated in Section 01 77 00.
 - d. Removal of temporary facilities and services.
 - e. Removal of surplus materials, rubbish, or similar elements.
 - f. Final cleaning.
 - g. Transmittal of project construction record documents to OWNER and ENGINEER.
 - h. Consent of surety for final payment.
- B. The Jordan Valley Water Conservancy District Board must approve all pay estimates for construction contracts before payment can be made. The District Board normally meets on the third Wednesday of the month to consider payments on construction contracts. To allow adequate time to prepare the monthly estimates, the cut-off date for work items to be included in the estimate and delivered to the Engineer shall be by noon of the last Wednesday of the month. This will be further detailed at the pre-construction meeting.

1.04 SUBSTANTIATING DATA

- A. When Engineer requires substantiating information, submit data justifying dollar amounts in question.
- B. Provide one (1) copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.
- C. Provide copies of invoice(s) for payment of materials stored on-site. Payment will not be made for materials that are not stored on-site or within a bonded warehouse that has been approved by Engineer and Owner.
- D. Contractor shall supply substantiating information in compliance with federal and state requirements for monthly utilization reports and weekly prevailing wage and labor rates for laborers on-site.

PART 2 PRODUCTS

2.01 NOT USED.

PART 3 EXECUTION

3.01 NOT USED.

END OF SECTION

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SECTION 01 31 13
PROJECT COORDINATION

PART 1 **GENERAL**

1.01 SUMMARY

A. This Section includes:

1. Coordination and project conditions.
2. Field engineering.

B. Related Sections include:

1. Section 01 11 00 – Summary of Work.
2. Section 01 29 76 – Progress Payment Procedures.
3. Section 01 33 00 – Submittal Procedures.
4. Section 01 77 00 – Closeout Procedures.

1.02 COORDINATION AND PROJECT CONDITIONS

A. General:

1. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
2. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
3. Coordinate space requirements, supports, and installation of mechanical and electrical Work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
4. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
5. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.
6. Coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

B. Responsibilities of the Contractor:

1. Afford other Contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their Work.
2. Connect and coordinate Work with other Contractors Work as required by the Contract Documents.
3. Allocate and coordinate use of Site for field offices and construction trailers and for access, traffic, and parking facilities.
4. Instruct and coordinate the use of temporary utilities and construction facilities.
5. Coordinate field engineering and layout Work.
6. Verify all shop drawing dimensions.
7. Coordinate the Work of the individual Contractors.
8. Submit (and revise) progress schedule in accordance with Section 01 33 00 – Submittal Procedures coordinating the entire project construction schedule.
9. Organize and submit Applications for Payment. Submit applications on Payment Application and Certificate L-1 forms for review by Engineer.
10. Submit shop drawings, product data, and samples in accordance with Section 01 33 00 – Submittal Procedures.
11. Submit request for interpretation of Contract Documents and obtain instructions through Engineer.
12. Process requests for Change Orders through Engineer.
13. Organize all closeout submittals and preliminary inspection reports for transmittal to Engineer. Organize all record drawings and submit to Engineer. Review all drawings before submitting to Engineer.
14. Notify Engineer when all trades are ready for final inspection and organize Substantial and Final inspections.
15. Provide record drawing information to Engineer.
16. Ensure punch list items are completed prior to scheduling final inspection by Engineer.

1.03 FIELD ENGINEERING

- A. Control datum for construction is that shown on Drawings.
- B. Contractor shall locate and protect survey control and reference points.
- C. Contractor shall confirm Drawing dimensions and elevations. Notify Engineer concerning errors or ambiguities.
- D. Contractor shall establish and maintain required elevations, lines, and levels utilizing recognized engineering practices. Obtain services of a licensed surveyor as required to assure Work is installed per Drawing dimensions and elevations.

- E. Site service utilities are shown in their approximate locations on the Drawings. Contractor shall be responsible to field verify all utility locations as required to accommodate construction activities.
- F. Utility construction staking shall be responsibility of Contractor.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

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SECTION 01 31 19
PROJECT MEETINGS

PART 1 **GENERAL**

1.01 SUMMARY

- A. This Section includes:
 - 1. Preconstruction meeting.
 - 2. Site mobilization meeting.
 - 3. Progress meetings.
 - 4. Preinstallation meeting.
- B. Related Sections include:
 - 1. Section 01 11 00 – Summary of Work.
 - 2. Section 01 77 00 – Closeout Procedures.

1.02 PRECONSTRUCTION MEETING

- A. Engineer will schedule a meeting at the Project Site after Notice of Award.
- B. Attendance required by
 - 1. Contractor's Project Manager.
 - 2. Contractor's superintendent.
 - 3. Owner.
 - 4. Engineer.
 - 5. Major Subcontractor(s).
- C. Agenda:
 - 1. Contract Forms and Conditions of the Contract.
 - 2. Distribution of Contract Documents.
 - 3. Submission of list of Subcontractors, list of products, schedule of values, and progress schedule.
 - 4. Designation of personnel representing the parties in Contract, and the Engineer.
 - 5. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 6. Scheduling.
 - 7. Use of premises by Owner and Contractor.
 - 8. Procedures for testing.
 - 9. Procedures for maintaining record documents.
 - 10. Requirements of the primacy agencies.

- D. Engineer will record minutes and distribute copies after meeting within fourteen (14) days to participants and those affected by decisions made.

1.03 SITE MOBILIZATION MEETING

- A. Engineer and Owner will schedule a meeting at the Project Site prior to Contractor occupancy.

- B. Attendance required by:

1. Contractor(s).
2. Contractor's Superintendent(s).
3. Owner.
4. Engineer.
5. Major Subcontractor(s).

- C. Agenda:

1. Use of premises by Owner and Contractor.
2. Owner's requirements and partial occupancy.
3. Construction facilities and controls provided by Owner.
4. Temporary utilities provided by Owner.
5. Survey and building layout.
6. Security and housekeeping procedures.
7. Procedures for testing.
8. Requirements for start-up of equipment.
9. Inspection and acceptance of equipment put into service during construction period.
10. Procedures for maintaining record documents.

- D. Engineer will record minutes and distribute copies after meeting within fourteen (14) days to participants and those affected by decisions made.

1.04 PROGRESS MEETINGS

- A. Engineer will:

1. Schedule and administer meetings at the Project site throughout progress of the Work at weekly intervals, or as deemed necessary by the Engineer.
2. Make arrangements for hosting meetings.

- B. Attendance required by:

1. Contractor
2. Contractor(s) Job Superintendent.
3. Owner.
4. Engineer.

5. Major Subcontractors and suppliers.
6. Others as appropriate to agenda topics for each meeting.

C. Agenda:

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Review of Site Safety
4. Field observations, problems, and decisions.
5. Identification of problems which impede planned progress.
6. Review of submittals schedule and status of submittals.
7. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding Work period.
11. Coordination of projected progress.
12. Maintenance of quality and Work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Other business relating to Work.

- D. Engineer will record minutes and distribute copies within seven (7) days after meeting to participants and those affected by decisions made.

1.05 PREINSTALLATION MEETING

- A. When required in individual Specification sections, convene a preinstallation meeting at the site prior to commencing Work of the section.

1. Require attendance of parties directly affecting, or affected by, Work of the specific section.
2. Notify Engineer seven (7) days in advance of meeting date.
3. Prepare agenda and preside at meeting.
4. Review conditions of installation, preparation and installation procedures.
5. Review coordination with related Work.

- B. Engineer will record minutes and distribute copies within fourteen (14) days after meeting to participants and those affected by decisions made.

PART 2 PRODUCTS

2.01 NOT USED.

PART 3 EXECUTION

3.01 NOT USED.

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 **GENERAL**

1.01 SUMMARY

A. This Section includes:

1. Submittal Procedures.
2. Submittal Schedules
3. Construction Progress Schedules.
4. Proposed Products List.
5. Tabulation of Subcontractors.
6. Tabulation of Suppliers.
7. Request for Interpretation.
8. Product Data.
9. Shop Drawings.
10. Samples.
11. Test Reports.
12. Manufacturer's Certificates.
13. Manufacturer's Instructions.
14. Manufacturer's Field Reports.
15. Excessive Shop Drawing Reviews.
16. DBE Compliance.

B. Related Sections include:

1. Section 01 45 00 – Quality Control.
2. Section 01 77 00 – Closeout Procedures.
3. Section 01 78 23 – Operations and Maintenance Data.
4. Divisions 2 through 43.

1.02 SUBMITTAL PROCEDURES

- A. Transmit each submittal with Engineer accepted form.
- B. Sequentially number the transmittal form. Submit revised submittals with original number and a sequential alphabetic suffix.
- C. CONTRACTOR shall send each submittal in electronic format to be distributed by Engineer for review. Upon approval, Contractor shall submit four (4) hard copies to be retained by ENGINEER and ENGINEER'S Subconsultants.
- D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate.

- E. Contractor shall completely review all submittal materials prior to submission to Engineer. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- F. Schedule submittals to expedite the Project, and deliver to Engineer at business address. Coordinate submission of related items.
- G. ENGINEER will attempt to complete a review of each submittal in a timely manner within 30 calendar days of receipt of each submittal. Failure of ENGINEER to review a submittal within the estimated review timeframe shall not be basis for the CONTRACTOR to request or receive additional Contract Price or Contract Time.
- H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
Highlight and/or clearly designate specific product details and information so as to confirm product meets or exceeds Specifications.
- I. Provide space for Contractor and Engineer review stamps.
- J. When revised for resubmission, identify all changes made since previous submission.
- K. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements. Clearly transmit Engineer review comments to suppliers and subcontractors as required to minimize product delivery errors and miscommunications.
- L. Submittals not requested will not be recognized or processed.
- M. ENGINEER will review submittals in order received unless CONTRACTOR requests, in writing, a revised order of review. A revision in order may add to the length of review time required for previously submitted submittals.
- N. Submittal of more than three major submittals per week may add to the required length of review time. ENGINEER shall notify CONTRACTOR of submittal review scheduling conflicts.

1.03 SUBMITTAL SCHEDULES

- A. CONTRACTOR shall submit a schedule of submittal dates for shop drawings, product data, and samples.

- B. The submittal schedule shall identify specification sections and anticipated submittal dates. Indicate any critical submittals and dates for ENGINEER'S review.
- C. Provide decision dates for selection of finishes and samples.

1.04 CONSTRUCTION PROGRESS SCHEDULES

- A. Submit initial schedule in duplicate within 15 days after date of Owner-Contractor Agreement.
- B. Revise and resubmit as required.
- C. Submit revised schedules with each Application for Payment, identifying changes since previous version. Application for Payment will not be processed until updated construction schedule has been submitted.
- D. Prepare schedules as a horizontal bar chart with separate bar for each major portion of Work or operation, identifying first workday of each week as well as the proposed start and completion dates of each major portion of Work.
- E. Sheet Size: Minimum 11x17 inches. Large sizes than 11x17 inches shall be in multiples of 8½x11 inches.
- F. Content
 - 1. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction. Indicate the early and late start, early and late finish, float dates, and duration.
 - 2. Identify each item by Specification section number.
 - 3. Identify Work of separate stages and other logically grouped activities.
 - 4. Provide sub-schedules to define critical portions of the entire schedule.
 - 5. Include conferences and meetings in schedule.
 - 6. Indicate estimated percentage of completion for each item of Work at each submission.
 - 7. Provide separate schedule of submittal dates for shop drawings, product data, and samples, and dates reviewed submittals will be required from Engineer. Allow sufficient time for review by Engineer. Indicate decision dates for selection of finishes.
 - 8. Coordinate content with schedule of values.
- G. Provide narrative report to define problem areas, anticipated delays, and impact on Schedule.
- H. Distribution

1. Distribute copies of reviewed schedules to Project Site file, Subcontractors, suppliers, and other concerned parties.
2. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

1.05 PROPOSED PRODUCTS LIST

- A. Within fifteen (15) days after date of Owner-Contractor Agreement, submit list of major Products proposed for use, with name of manufacturer, trade name, and model number of each Product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.06 TABULATION OF SUBCONTRACTORS

- A. CONTRACTOR shall submit a complete list of subcontractors who will provide work on the project.
- B. The submitted list shall include the following information for each subcontractor:
 1. Name
 2. Address
 3. Type of work to be provided
 4. Applicable specifications sections
 5. Contact person
- C. CONTRACTOR'S use of specific subcontractors shall be subject to the requirements included in the specifications.

1.07 TABULATION OF SUPPLIERS

- A. CONTRACTOR shall submit a list of suppliers who will provide materials, equipment, or components which are integral to the Work.
- B. The submitted list shall include the following information for each subcontractor:
 1. Name
 2. Address
 3. Type of work to be provided
 4. Applicable specifications sections
 5. Contact person
- C. CONTRACTOR'S use of specific suppliers for providing equipment, materials, or components shall be subject to the requirements of the specifications.

1.08 REQUESTS FOR INTERPRETATION

- A. CONTRACTOR shall submit in writing all requests for interpretation or for information regarding the Contract Documents on the form provided by the ENGINEER.
- B. ENGINEER does not guarantee that a response can be provided in the amount of time requested, but ENGINEER shall respond in writing to CONTRACTOR'S request within a reasonable amount of time given the extent of the request for interpretation of information required.

1.09 PRODUCT DATA

- A. Submitted to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.
- B. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article above and for record document purposes described in Section 01 77 00.
- C. Submit the number of copies that the Contractor requires, plus five (5) copies that will be retained by the Engineer and Engineer's Subconsultant.
- D. Mark each copy to identify applicable Products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- E. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service of functional equipment and appliances.
- F. Premium and High Efficiency Product Data: The District will participate in various rebate programs for premium and high-efficiency equipment and products. Provide Proof of Purchase and Compliance product data as needed to complete the various rebate forms. Rebate forms are included as attachments to Section 01 61 00 – Common Product Requirements.

1.10 SHOP DRAWINGS

- A. Submitted to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.
- B. After review, produce copies and distribute in accordance with SUBMITTAL PROCEDURES article above and for record document purposes described in Section 01 77 00.

- C. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Submit in electronic format for ENGINEER'S review.
- E. All shop drawings shall be submitted through the CONTRACTOR in accordance with the procedures outlined in this specification. Shop drawings received from anyone other than through the CONTRACTOR will not be reviewed.
- F. Shop drawings shall include data and technical drawings prepared specifically for this Project, including where required, but not limited to the following:
 - 1. Fabrication drawings
 - 2. Installation drawings
 - 3. Shopwork manufacturing instructions
 - 4. Templates or patterns
 - 5. Coordination drawings
 - 6. Schedules
 - 7. Design calculations
- G. Shop drawings shall contain complete detail showing conformance with the Contract Documents and such other specified information as required, including but not limited to the following
 - 1. Related work with applicable cross references
 - 2. Physical configuration
 - 3. Dimensional information, including any variations from actual conditions
 - 4. List of materials
 - 5. Structural construction and assemblies
 - 6. Anchor bolt details showing type, size, embedment, and locations
 - 7. Machinery and equipment details
 - 8. Auxiliary items to machinery and equipment
 - 9. Protective coatings and factory finishes
 - 10. Electrical information including motor sizes, wiring and circuit diagrams, and instrumentation
 - 11. Testing results
- H. Detail all connections required to complete the work.
- I. Approval of shop drawings by ENGINEER shall not relieve the CONTRACTOR from responsibility of deviations from drawings or specification, unless deviations or changes have been brought to ENGINEER'S attention at time of submission, nor shall it relieve the CONTRACTOR from responsibility for errors or omissions in shop drawings.

1.11 SAMPLES

- A. Submitted to Engineer for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- B. After review, produce duplicates and distribute in accordance with SUBMITTAL PROCEDURES article above and for record document purposes described in Section 01 77 00.
- C. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
- D. Include identification on each sample, with full Project information.
- E. Submit the number of samples specified in individual Specification sections; one (1) of which will be retained by Engineer.
- F. Reviewed samples that may be used in the Work are indicated in individual Specification sections.
- G. Samples will not be used for testing purposes unless specifically stated in the Specification section.

1.12 TEST REPORTS

- A. Submit for the Engineer's knowledge as Contract Administrator or for the Owner.
- B. Submit test reports for information for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.
- C. Retain one (1) copy of all test reports and results on-site in a location accessible to Engineer.

1.13 MANUFACTURER'S CERTIFICATES

- A. When specified in individual Specification sections, submit certification by the manufacturer, installation/application Subcontractor, or the Contractor to Engineer, in quantities specified for Product Data.
- B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Engineer.

1.14 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Engineer for delivery to Owner in quantities specified for Product Data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- C. Refer to Section 01 45 00 – Quality Control, Manufacturers' Field Services article.

1.15 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for the Engineer's benefit as Contract Administrator or for the Owner.
- B. Submit report in duplicate within 15 days of observation to Engineer for information.
- C. Submit the manufacturer's field reports for the limited purpose of assessing conformance with information given and the design concept expressed in the Contract Documents.

1.16 EXCESSIVE SHOP DRAWING REVIEWS

- A. The maximum number of submittal reviews for any one product or specification section shall be two (2). If Owner or Engineer initiate a product or design change one (1) more submittal review can be approved without additional compensation.
- B. Compensation for third or subsequent reviews will be required as outlined below:
 - 1. OWNER will compensate ENGINEER for "additional services".
 - 2. OWNER will deduct amount of such compensation from payment to CONTRACTOR.
 - 3. ENGINEER'S compensation shall be at ENGINEER'S standard hourly rates, plus reimbursable expenses at cost.

PART 2 **PRODUCTS**

NOT USED.

PART 3 **EXECUTION**

NOT USED.

END OF SECTION

SECTION 01 45 00
QUALITY CONTROL

PART 1 **GENERAL**

1.01 SUMMARY

A. Section includes:

1. Quality Assurance - Control of Installation.
2. Tolerances.
3. References and Standards.
4. Testing Responsibilities.
5. Inspection and Testing Services.
6. Mill Tests.
7. Factory Tests.
8. Manufacturer's Instructions.
9. Manufacturer's Certificates.
10. Manufacturers' Field Services.
11. Qualification Tests.
12. Laboratory Tests.
13. Product Field Tests.
14. Material Field Tests.
15. Coating Field Tests.
16. Mock – up.
17. Construction Vibration Monitoring

B. Related Sections include:

1. Section 01 33 00 – Submittal Procedures.
2. Section 01 45 33 - Code-Required Special Inspections
3. Section 01 75 00 – Starting and Adjusting.
4. Divisions 02 through 43.

1.02 QUALITY ASSURANCE - CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturer's instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform Work by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on Contract Drawings, shop drawings, or as instructed by the manufacturer.
- G. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
- H. Completed Work shall be plumb, level, true to line or plane, and free from damage.

1.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.04 REFERENCES AND STANDARDS

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where a specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Engineer shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.05 TESTING RESPONSIBILITIES

- A. Contractor's Responsibility:
 - 1. Contractor shall be responsible for all quality control testing or inspections including mill tests, factory tests, qualification tests, laboratory tests, and

field tests other than those required and specified in Parts 1.15 and 1.16 below.

2. Quality control required by codes or ordinances, or by the plan approval authority, unless otherwise provided in the Contract Documents.
3. Contractor's convenience testing.
4. Coordinate with each independent agency to accommodate required services with minimum delay in progress of work, and to avoid moving or replacing work. Schedule times for quality control services.
5. Cooperate with independent agencies performing required quality control services. Notify testing agency sufficiently in advance of operations to permit assignment of personnel. Provide auxiliary services as required, including, but not limited to the following:
 - a. Providing access to work
 - b. Taking samples or assistance with taking samples
 - c. Delivery of samples to testing laboratories
 - d. Security and protection of samples and test equipment at Site
6. Contractor shall be responsible for vibration monitoring and reporting at two locations on the WTP site starting a minimum of one week before construction starts and continuing for the duration of construction.

B. Owner's Responsibility:

1. Owner responsible quality control shall be specifically indicated. If quality control measure is not indicated as Owner responsibility it is the Contractor's responsibility.

C. Retesting Responsibility:

1. Where results of quality control prove unsatisfactory and do not indicate compliance with Contract Documents all costs associated with retesting is the Contractor's responsibility.
2. The costs for retesting of Owner responsible quality control shall be deducted from the Contract amount by supplemental agreement.

1.06 INSPECTION AND TESTING SERVICES

A. The Owner shall appoint, employ, and pay for specified services of an independent firm to perform testing including:

1. Concrete materials and mix designs.
2. Concrete formwork.
3. Concrete reinforcement.
4. Masonry walls.
5. Structural Steel.
6. Asphaltic materials and mix designs.
7. Embedment and backfill materials.

8. Soil Density.
 9. Applied Fireproofing
 10. Intumescent Mastic Fireproofing
 11. Bacteriological testing.
 12. Weld Radiographs and Weld Inspection Report.
 13. All other tests and engineering data required for Engineer's review of materials and equipment proposed to be used in the Work. Contractor shall obtain Engineer's acceptance of the testing firms before having services performed, and shall pay all costs for these testing services. All costs for testing shall be incidental.
- B. The independent firm will perform tests and other services specified in individual specification sections and as required by the Engineer.
- C. Testing and source quality control may occur on or off the project site. Perform off-site testing as required by the Engineer or the Owner.
- D. Reports will be submitted by the independent firm to the Owner, Building Official, Engineer and Contractor, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.
- E. The Owner will select an independent testing agency qualified in accordance with referenced ASTM standards and that is acceptable to the Engineer, if required for certain types of testing.
- F. Comply with pertinent codes, regulations, and industry standards except when more stringent standards or tolerances are specified.
- G. The contractor shall cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
1. Notify Engineer and independent firm 48 hours prior to expected time for operations requiring services.
 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- H. Testing does not relieve Contractor from performing Work according to contract requirements.
- I. Re-testing required because of non-conformance to specified requirements shall be performed by the same independent firm on instructions by the Engineer. Payment for re-testing will be paid by the Contractor.

1.07 MILL TESTS

- A. Mill or shop tests shall be conducted and test reports submitted where this type of test is specified.

- B. Mill or shop tests shall be accomplished by the manufacturer or fabricator of the materials. Mill tests may be conducted by an independent testing laboratory. These tests shall be performed in accordance with applicable ASTM standards.

1.08 FACTORY TESTS

- A. Factory tests of process, mechanical, and electrical equipment relative to performance, capacity, rating, efficiency, or other such requirements shall be conducted in the factory or shop for each item supplied when this type of test is specified.
- B. Factory testing shall be performed in accordance with applicable standards and test codes.
- C. Where factory tests are required or specified, reports of the test results shall be submitted to ENGINEER for approval prior to shipment. CONTRACTOR shall submit the number of test reports for approval required by the CONTRACTOR plus four (4) copies to be retained by the ENGINEER.
- D. Factory observation of fabrication procedures, materials used, and testing methods may be performed by a representative of the OWNER or ENGINEER. OWNER shall pay for factory observation.

1.09 MANUFACTURERS' INSTRUCTIONS

- A. Comply with manufacturer's instructions in full detail for storage, installation, assembly, installation, start-up, and adjustment. CONTRACTOR shall follow appropriate sequencing as recommended by manufacturer.
- B. Should manufacturer's instructions conflict with Contract Documents, CONTRACTOR shall request clarification from ENGINEER prior to proceeding.
- C. If required by individual product or equipment specification sections, CONTRACTOR shall submit manufacturer's printed instructions prior to assembly and installation.

1.10 MANUFACTURERS' CERTIFICATES

- A. Submit manufacturer's certificate indicating that equipment or products meet or exceed specified requirements where required in the individual specification sections.
- B. Certificates shall be submitted prior to shipment of equipment or products.

1.11 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and other services as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer subject to approval of Engineer.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00.

1.12 QUALIFICATION TESTS

- A. Should a product, material, or method for assembly of unknown or questionable quality to the ENGINEER be proposed by the CONTRACTOR, additional tests may be required by the ENGINEER.
- B. Additional testing as required by the ENGINEER shall be used as a basis to establish acceptance or rejection.

1.13 LABORATORY TESTS

- A. Laboratory tests shall be conducted and test reports shall be submitted where this type of test is specified. All laboratory tests shall be made by an independent laboratory approved by the ENGINEER. These tests shall be performed in accordance with applicable ASTM standards.
- B. Laboratory tests may be witnessed by representatives of the OWNER or ENGINEER.
- C. Submit two (2) copies of all laboratory tests to the ENGINEER for record.

1.14 PRODUCT FIELD TESTS

- A. Product field tests shall be set up and completed by the CONTRACTOR. CONTRACTOR shall provide all tools, equipment, instruments, personnel, and other facilities required for the completion of each test.
- B. Product field tests of process equipment, mechanical systems, electrical systems, piping systems, and similar facilities shall be conducted where this type of test is specified.

- C. Product field tests include the determination of performance, capacity, efficiency, function, tightness, leakage, and other special requirements. Product field tests shall be performed in accordance with applicable standards and test codes.
- D. Product field tests may be witnessed by representatives of OWNER and ENGINEER.
- E. Submit two (2) copies of all product field tests to the ENGINEER for record.

1.15 MATERIALS FIELD TESTS

- A. Routine tests of materials incorporated into the Project will be performed by an independent testing laboratory arranged and paid for by the Owner and acceptable to the ENGINEER.
- B. Results of materials field testing shall be reported to the ENGINEER and CONTRACTOR.
- C. Material field tests may be witnessed by representatives of the OWNER, ENGINEER, and ENGINEER'S subconsultant and such witnessing shall be paid for by the OWNER.
- D. CONTRACTOR shall provide at least two different certified gradation tests from each source of materials provided for the project site or one (1) sample from each 1,500 tons of finished product used. Certified gradation tests shall be done in accordance with ASTM C136 and be performed by the independent testing laboratory hired by the CONTRACTOR.
- E. CONTRACTOR shall provide at least two (2) different certified moisture-density relationship (compaction curve) tests from each source of materials provided to the project site. Certified moisture-density relationship tests shall be done in accordance with ASTM D698 and be performed by the independent testing laboratory hired by the CONTRACTOR.
- F. The following inspections and testing shall be conducted by the independent testing laboratory hired by the OWNER and accepted by the ENGINEER with results being reported to the CONTRACTOR and ENGINEER. See Structural Special Inspection Tables on Drawings for additional requirements.

- 1. Excavating, Filling, and Grading Soil Compaction Testing: Verify Compaction using nuclear tests, ASTM D2922.

Item	Frequency	Standard Proctor (ASTM D698) Density

Building or Structure Sites and Roadway and Parking Area Subgrade Preparation (excavation areas)	One (1) approved test per 1,000 sf of any area that indicate soil bearing capacity as required.	95%
Roadway and Parking Area Subgrade Preparation (fill areas)	One (1) approved test per 2,000 sf per 4-foot lift.	95%
Building or Structure Sites (fill areas)	One (1) approved test per 1,000 sf per 8-inch compacted lift of all fill materials.	95%
Utility and Piping Trenches	One (1) approved test per 500 feet of trench per 100-feet of trench per lift under structures, and paved areas.	95%
Aggregate Base	Proof roll all pavement areas.	
Parking Areas and Sidewalks	Proof roll all areas subject to vehicle traffic.	

2. Concrete Specimens:
 - a. Cast four (5) cylinders per set – one (1) at 7 days, two (3) at 28 days, and one (1) for 54 days.
 - b. Cast one set of cylinders for five (5) cubic yards or larger per unit or structure. Cast an additional set of cylinders for each additional 50 cubic yards of cast-in-place concrete or masonry grout.
 - c. Where field-cured companion cylinders are specifically noted, 2 per set shall be cast, field cured and tested.
 - d. Where the Contractor elects to prepare field-cured companion cylinders for their own use to determine early curing periods, at least two (2) cylinders shall be tested at each desired curing period. A test of less than 2 cylinders will not be acceptable as proof of achievement of specified curing strengths. The costs of all companion cylinders not specifically required shall be the cost of the Contractor and not the Owner.

- e. Standard tests to be performed on fresh concrete each time cylinders are cast are slump, air content, and temperature.
- f. Concrete temperature shall be tested hourly, and recorded, when air temperature is 40 degrees F and below, and when 80 degrees F and above.
- g. See Section 01 45 33 Code Required Special Inspections and Procedures and Division 03- Concrete and Drawings for additional requirements.
- 3. Bituminous Specimens:
 - a. Obtain samples of placed bituminous prior to bituminous being rolled at the rate of one (1) sample per 100-ton of each mix placed per lift with a minimum of one (1) sample per mix per lift per day. CONTRACTOR shall cooperate with ENGINEER in obtaining the samples.
 - b. Perform testing for gradation and extraction on each sample.
- 4. All Structural Welding:
 - a. Visual observation at all connections.
 - b. Non-Destructive testing at full or partial penetration welds.
 - 1) Weld Radiographs and Weld Inspection Report.
 - c. See Drawings and specification section 01 45 33 and Division 05 for additional requirements.
- 5. High Strength Bolting for Structural Steel
 - a. Visual observation at all connections.
 - b. Tension testing for ten (10) percent of all connections with a minimum of two (2) bolts per connection.
 - c. See Drawings and specification section 01 45 33 and Division 05 for additional requirements.
- 6. Masonry:
 - a. See Drawings and specification section 01 45 33 and Division 05 for additional requirements.

1.16 COATINGS FIELD TESTS

- A. An independent testing company hired by the Owner will provide testing of coatings and coating systems. Owner shall pay for testing of coatings and coating systems.

1.17 MOCK-UP

- A. Tests will be performed under provisions identified in this Section and identified in the respective product specification Sections.
- B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mock-ups shall be a comparison standard for the remaining work.
- D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so.

1.18 CONSTRUCTION VIBRATION MONITORING

- A. Vibration producing activities (such as blasting, pile driving, vibratory compaction, pavement breaking or operation of heavy construction equipment) may be required for construction of this project. The Contractor is advised that structures are located close to the proposed work and that construction activities shall be conducted so as to preclude damage to these structures and undue annoyance to occupants. The contractor shall be responsible for all damage caused by his activities
- B. Contractor shall be responsible for vibration monitoring and reporting at two locations on the WTP site starting a minimum of one week before construction starts and continuing for the duration of construction. Reports shall be submitted to the Engineer.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify that utility services are available, of the correct characteristics, and in the correct locations.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

END OF SECTION

SECTION 01 45 33
CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Code-required special inspections.
- B. Testing services incidental to special inspections.
- C. Submittals.

1.02 RELATED REQUIREMENTS

- A. Section 01 45 00 - Quality Control.
- B. Section 01 61 00 - Common Product Requirements.

1.03 ABBREVIATIONS AND ACRONYMS

- A. NIST: National Institute of Standards and Technology.

1.04 DEFINITIONS

- A. Code or Building Code: ICC (IBC)-2015, Edition of the International Building Code and specifically, Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. National Institute of Standards and Technology (NIST).
- D. Special Inspection:
 - 1. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.05 REFERENCE STANDARDS

- A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2011.
- B. AISC 360 - Specification for Structural Steel Buildings; 2010.
- C. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2015ae1.

- D. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2014a.
- E. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.
- F. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection and/or Testing; 2014a.
- G. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
- H. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014.
- I. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010 (Reapproved 2015).
- J. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.
- K. ICC (IBC) - International Building Code; 2015.
- L. ICC (IBC)-2015 - International Building Code; 2015.
- M. SDI QA/QC - Standard for Quality Control and Quality Assurance for Installation of Steel Deck; 2022.

1.06 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
 - 1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
- C. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Engineer and one to the AHJ.
 - 1. Include:

- a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of special inspection.
 - h. Date of special inspection.
 - i. Results of special inspection.
 - j. Compliance with Contract Documents.
 - 2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.
- D. Certificates: When specified in individual special inspection requirements, Special Inspector shall submit certification by the manufacturer, fabricator, and installation subcontractor to Engineer and AHJ, in quantities specified for Product Data.
- 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

1.07 SPECIAL INSPECTION AGENCY

- A. Owner or Engineer will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.
- B. The Special Inspection Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.
- C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.08 QUALITY ASSURANCE

- A. Special Inspection Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

- A. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
 - 1. Continuous Special Inspection: Special Inspection Agency is required to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspection: Special Inspection Agency is required to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.

3.02 SPECIAL INSPECTIONS FOR STEEL CONSTRUCTION

- A. Structural Steel: Comply with quality assurance inspection requirements of ICC (IBC).
- B. Cold-Formed Steel Deck: Comply with quality assurance inspection requirements of SDI QA/QC.

3.03 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION

- A. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved Contract Documents and ACI 318, Sections 3.5 and 7.1 through 7.7; periodic.
- B. Bolts Installed in Concrete: Where allowable loads have been increased or where strength design is used, verify compliance with approved Contract Documents and ACI 318, Sections 8.1.3 and 21.2.8 prior to and during placement of concrete; continuous.
- C. Design Mix: Verify plastic concrete complies with the design mix in approved Contract Documents and with ACI 318, Chapter 19, 16.4.3, 26.4.4; periodic.
- D. Design Mix: Verify plastic concrete complies with the design mix in approved Contract Documents and with ACI 318, Chapter 4 and 5.2; periodic.
- E. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172/C172M, ASTM C31/C31M and ACI 318, Chapter 26.5, 26.12, and record the following, continuous:
 - 1. Slump.

2. Air content.
 3. Temperature of concrete.
- F. Specified Curing Temperature and Techniques: Verify compliance with approved Contract Documents and ACI 318, Sections 5.11 through 5.13; periodic.
- G. Concrete Strength in Situ: Verify concrete strength complies with approved Contract Documents and ACI 318, Section 6.2, for the following.
- H. Formwork Shape, Location and Dimensions: Verify compliance with approved Contract Documents and ACI 318, Section 6.1.1; periodic.

3.04 SPECIAL INSPECTIONS FOR MASONRY CONSTRUCTION

- A. Masonry Structures Subject to Special Inspection:
1. Empirically designed masonry, glass unit masonry and masonry veneer in structures designated as "essential facilities".
 - a. Perform inspections in accordance with Level B Quality Assurance.
- B. Verify each item below complies with approved Contract Documents and the applicable articles of TMS 402/602.
1. Inspections and Approvals:
 - a. Verify compliance with the required inspection provisions of the approved Contract Documents; periodic.
 - b. Verify approval of submittals required by Contract Documents; periodic.
 2. Compressive Strength of Masonry: Verify compressive strength of masonry units prior to start of construction unless specifically exempted by code; periodic.
 3. Slump Flow and Visual Stability Index (VSI): Verify compliance as self consolidating grout arrives on site; continuous.
 4. Grouting Preparation: Prior to grouting, verify:
 - a. Grout space is clean; periodic.
 - b. Correct placement of reinforcing, connectors, prestressing tendons and anchorages; periodic.
 - c. Correctly proportioned site prepared grouts and prestressing grout for bonded tendons; periodic.
 - d. Correctly constructed mortar joints; periodic.
 5. Preparation of Grout Specimens, Mortar Specimens and Prisms: Observe preparation of specimens; periodic.

3.05 SPECIAL INSPECTIONS FOR SOILS

- A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.

1. Design bearing capacity of material below shallow foundations; periodic.
2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
3. Materials, densities, lift thicknesses; placement and compaction of backfill: continuous.
4. Subgrade, prior to placement of compacted fill verify proper preparation; periodic.

B. Testing: Classify and test excavated material; periodic.

3.06 SPECIAL INSPECTIONS FOR FIRE RESISTANT PENETRATIONS AND JOINTS

A. Verify penetration firestops in accordance with ASTM E2174.

B. Verify fire resistant joints in accordance with ASTM E2393.

3.07 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

A. Special Inspection Agency shall:

1. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
2. Perform specified sampling and testing of products in accordance with specified reference standards.
3. Ascertain compliance of materials and products with requirements of Contract Documents.
4. Promptly notify Engineer and Contractor of observed irregularities or non-compliance of work or products.
5. Perform additional tests and inspections required by Engineer.
6. Submit reports of all tests or inspections specified.

B. Limits on Special Inspection Agency Authority:

1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency may not approve or accept any portion of the work.
3. Agency may not assume any duties of Contractor.
4. Agency has no authority to stop the work.

C. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Engineer.

D. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

3.08 CONTRACTOR DUTIES AND RESPONSIBILITIES

A. Contractor Responsibilities, General:

1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
2. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
3. Provide incidental labor and facilities:
 - a. To provide access to work to be tested or inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
 - c. To facilitate tests or inspections.
 - d. To provide storage and curing of test samples.
4. Notify Engineer and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.

END OF SECTION

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SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Temporary Lighting for Construction Purposes.
2. Fire Protection.
3. Temporary Water Service.
4. Temporary Sanitary Facilities.
5. First Aid Facilities.
6. Fencing.
7. Barriers.
8. Enclosures.
9. Temporary Controls.
 - a. Storm Water Permits.
 - b. Dust Control
 - c. Noise Control
 - d. Road Cleaning
10. Protection of Installed Work.
11. Temporary Construction Protection.
12. Security.
13. Parking.
14. Vehicle Access.
15. Progress Cleaning and Waste Removal.
16. Project Identification.
17. Field Offices and Sheds.
18. Removal of Utilities, Facilities, and Controls.

B. Related Sections include:

1. Section 01 11 00 – Summary of Work.
2. Section 01 60 00 – Common Product Requirements.
3. Section 01 77 00 –Closeout Procedures.
4. Division 26 – Electrical.

1.02 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. By Contractor

1. Refer to Division 26.

2. Contractor shall provide and pay for fuel-powered light plants or other light generating equipment for construction operations as required at all staging, assembly, and construction areas.
3. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
4. Maintain lighting and provide routine repairs.
5. Permanent building lighting may be utilized during construction.

1.03 FIRE PROTECTION

- A. CONTRACTOR shall provide and maintain in working order throughout the entire construction period fire extinguishing equipment in each separate construction area. Fire extinguishing equipment shall be of adequate size, number, and capacity for the required areas in accordance with all applicable codes and satisfactory to the local Fire Marshall.
- B. Fire extinguishers shall be non-freeze type such as A-B-C rated dry chemical and be of the size and capacity required for each individual area.
- C. CONTRACTOR shall provide and maintain in working order fire extinguishing equipment within enclosed construction sheds and field offices.

1.04 TEMPORARY WATER SERVICE

- A. CONTRACTOR shall verify location of temporary water supply on or near site and shall provide piping, hoses, meter, and fittings required to distribute it as required by the Work. CONTRACTOR shall supply approved backflow prevention and metering equipment.
- B. CONTRACTOR shall not be charged for reasonable water use throughout the construction period. CONTRACTOR shall make all reasonable efforts to conserve water. OWNER reserves the right to charge CONTRACTOR for water use deemed to be excessive.
- C. CONTRACTOR shall request authorization from OWNER to withdraw water volumes in excess of 50,000 gallons (i.e. filling basins and/or simulated operations) not less than 24 hours in advance of anticipated demand.
- D. CONTRACTOR shall not damage plumbing at source of temporary water.
- E. Where water source is not available at or near site, CONTRACTOR shall make arrangements with South Jordan City for source of water at appropriate locations Contractor shall adhere to all requirements.

1.05 TEMPORARY SANITARY FACILITIES

- A. Contractor shall provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide from time of project mobilization to final completion.

1.06 FIRST AID FACILITIES

- A. First aid facilities shall be provided and maintained by the CONTRACTOR in accordance with all federal, state, and local laws and regulations.

1.07 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Provide protection for plants designated to remain. Replace damaged plants.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.08 ENCLOSURES

- A. Provide temporary weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with locks; Owner shall have access to site at all times.
- B. Provide temporary partitions with access doors to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment. Temporary partitions shall be double walled made of wood framing and plastic sheeting (or approved equivalent) to completely seal off new Work from the rest of the existing facility. Dust is not allowed to enter the contained areas of the existing facility. All areas affected by dust will be cleaned at Contractor's expense and all motors affected by dust shall be replaced at Contractor's expense. Ventilation shall be provided for prep/coating Work and use of the existing building ventilation system is not acceptable. The Contractor shall exhaust the air to the exterior atmosphere at a minimum of 6 air changes per hour to prevent the buildup and migration of dust and fumes. All areas of the existing structure removed/altered shall be replaced or repaired to existing or better condition as determined by the Engineer

- C. Temperatures inside the enclosures and/or enclosed parts of structures shall be not less than 60 degrees F for 48 hours prior to and during time when concrete work, cement finishing, or masonry work are being completed or curing and not less than 50 degrees F when other trades are working.
- D. Provide temporary partitions and ceilings as required to separate work areas from existing OWNER occupied areas, to prevent the penetration of dust and moisture.
- E. Provide temporary closures over wall and floor openings to enclose work.

1.09 TEMPORARY CONTROLS

A. Storm Water Permits

1. CONTRACTOR shall obtain all necessary permits from Watershed Districts or responsible regulatory agencies for temporary erosion control measures. CONTRACTOR shall obtain an NPDES storm water permit for construction disturbing more than one acre of area in conjunction with the OWNER.
2. CONTRACTOR shall provide and maintain all best management practices necessary for erosion prevention, sediment control, dewatering and basin draining, and pollution prevention management measures at the Site in accordance with the requirements of the NPDES Storm Water permit and associated storm water pollution prevention plan (SWPPP) to be submitted to the MPCA following award of the contract and prior to beginning construction.
3. The SWPPP requirements are outlined in the project civil drawings and provide general best management practices that will be included in the SWPPP submitted to the MPCA. The SWPPP and NPDES shall be located at the site at all times during the construction. CONTRACTOR shall meet the general requirements as outlined in the project drawings and any additional requirements required as a part of the review and approval of the NPDES storm water permit and SWPPP.

B. Dust Control:

1. CONTRACTOR shall be responsible for dust control throughout the duration of the Project.
2. Work shall be executed by methods to minimize raising dust from construction operations.
3. Provide appropriate dust control measures as required to prevent excessive dust from dispersing into the air.

C. Noise Control:

1. CONTRACTOR shall be responsible for noise control throughout the duration of the Project.
2. Avoid the use of tools and equipment which produce harmful noise.
3. Restrict the use of noise making tools and equipment to required hours of construction.

D. Road Cleaning:

1. As required, the CONTRACTOR shall sweep or clean all roads and streets that are affected by vehicle traffic entering or leaving the site.

1.10 PROTECTION OF INSTALLED WORK

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.11 TEMPORARY CONSTRUCTION PROTECTION

- A. Shoring and Bracing:
 1. CONTRACTOR shall provide and maintain temporary supports, shoring, and bracing as required for protection of work.
 2. CONTRACTOR shall assure the adequacy of all temporary shoring and bracing.
 3. Repair or replace damaged work occasioned by inadequate temporary supports, shoring, or bracing.
 4. Leave temporary supports, shoring, and bracing in place until permanent construction is complete to point where installed work is properly supported.

1.12 SECURITY

- A. Provide security and facilities to protect Work, and existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program.
- C. Unexpected deliveries pose security concerns; therefore, Contractor shall inform
 - 1. Engineer and Owner of all equipment deliveries at least 24 hours in advance of
 - 2. equipment/material arrivals scheduled for delivery to Owner occupied facilities.
- D. Security will be the Contractors responsibility for any Work occurring after normal operating hours. Upon completion of this Work, Contractor shall ensure all facility doors and gates are locked and secure. No claims shall be made against Engineer or Owner for any act of Contractor's employee or trespasser, and Contractor shall make good on any damage to Owner's property, resulting from Contractor's failure to provide sufficient security in the absence of the Engineer and Owner.
- E. Contractor to discuss security with his employees and sub-contractors and advise them to immediately report anything suspicious which could be a security issue.

1.13 PARKING

- A. Contractor and personnel shall park all personal vehicles in an area acceptable to Owner and applicable property owners.
- B. Do not block or hinder access to local property, driveways, or walkways..

1.14 VEHICLE ACCESS

- A. By General Contractor.
 - 1. Maintain access roads leading into Site.
 - 2. Provide means of removing mud from vehicle wheels before entering streets and roads.
 - 3. Construct and maintain temporary roads accessing public roads to serve construction areas.
 - 4. Provide aggregate materials as an incidental to the Contract is access roads are not suitable for truck and equipment traffic or to accommodate local rainfall events.

5. When finished using access road(s) remove temporary access roads and return surface to pre-existing or better condition, as an incidental to the project.

B. Traffic Control:

1. Contractor shall provide and maintain signs, warning lights, and barricades to adequately protect warn and protect the public from hazardous protrusions, materials, excavations, and equipment resulting directly or indirectly from construction activities.
2. Contractor shall give Owner and Engineer at 48 hours notice prior to a partial blockage or closure of any street or public right of way. When working in the right of way of county roads, Contractor shall be responsible for acquiring the necessary permits for working in a right-of-way.
3. Traffic control devices shall be inspected daily. Warning lights should be checked for proper operation and cleaned as required. All broken or ineffective traffic control devices shall be replaced immediately.
4. Contractor shall designate an individual and one alternate to have responsible charge of proper installation and maintenance of the traffic control devices. These individuals shall be available on a 24-hour on call basis.

1.15 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum daily and mop weekly. Clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust. If Owner is not satisfied with Contractor's cleaning efforts, Owner reserves the right to charge Liquidated Damages for charges from a 3rd Party to appropriately clean the plant.
- D. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.
- E. Contractor shall maintain site clean and free of obstructions that may cause injuries or otherwise prevent staff (Owner, Engineer, Contractors, etc....) from performing their job effectively.

1.16 PROJECT IDENTIFICATION

A. Project Sign; By Contractor:

1. Include the following information:
 - a. Project Name.
 - b. Owner.
 - c. Engineer
 - d. Contractor
2. Erect on-site at location established by Engineer and Owner.

1.17 FIELD OFFICES AND SHEDS

- A. Construction Field Office (trailer or shed): At Contractor's option.
- B. Locate Field Offices and construction trailer or shed a minimum distance of 30 feet from existing and new structures. Owner's approval of location is required.

1.18 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials, prior to Final Application for Payment inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing and permanent facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

1.01 SUMMARY

- A. This Section includes:
 - 1. Products.
 - 2. Transportation and Handling.
 - 3. Storage and Protection.
 - 4. Product Options.
 - 5. Substitutions.
- B. Related Sections include, but are not limited to:
 - 1. Division 00 – Instruction to Bidders.
 - 2. Division 00 – General Conditions.
 - 3. Division 00 – Supplementary Conditions.
 - 4. Section 01 45 00 – Quality Control.

1.02 PRODUCTS

- A. Products: Means new material, machinery, components, equipment, fixtures, and systems forming the Work. Does not include machinery and equipment used for preparation, fabrication, conveying, and erection of the Work. Products may also include existing materials or components designated for re-use.
- B. All products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each product.
- C. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- D. Provide interchangeable components of the same manufacturer for components being replaced.
- E. Equipment covered by Division 26 shall be listed by UL, or by a nationally recognized third party testing laboratory. All costs associated with obtaining the listing shall be the responsibility of the Contractor. If no third-party testing laboratory provides the required listing, an independent test shall be performed at Contractor's expense. Before the test is conducted, Contractor shall submit a copy of the testing procedure to be used.

F. Premium and High Efficiency Products

1. The City of South Jordan participates in various rebate programs to promote installation of high and premium efficiency equipment and products. The Contractor shall supply the necessary information for the Owner to complete the rebate forms.
2. Premium and High Efficiency Products shall be as specified in their associated technical specifications.

1.03 TRANSPORTATION AND HANDLING

- A. Transport and handle Products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- C. Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.04 STORAGE AND PROTECTION

- A. Store and protect Products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive Products in weather tight, climate controlled, enclosures in an environment favorable to Product.
- D. For exterior storage of fabricated Products, place on sloped supports above ground.
- E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- F. Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.
- G. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

- J. Contractor shall be responsible to arrange for, receive, inspect, and unload all shipments of materials or equipment. Contractor shall provide haul route information to shipping companies.

1.05 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Any Product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with an option for an "Or Equal" or "Approved Equivalent" or "Prior Approved Equivalent" Manufacturer: Submit a request for the "or equal/approved equivalent" in accordance with the following substitutions article. Requests and Engineer's acceptance of "Or Equal" or "Approved Equal" or "Prior Approved Equivalent" Manufacturers is allowed during bidding only.

1.06 SUBSTITUTIONS

- A. Equal" or "Approved Equivalent" or "Acceptable" or "Prior Approved Equivalent" products will be considered during submittal reviews by the Engineer.
- B. Substitutions will be considered when a Product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that the Bidder: Contractor:
 - 1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - 2. Will provide the same warranty for the Substitution as for the specified Product.
 - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
 - 5. Will reimburse Owner and Engineer for redesign services associated with re-approval by authorities.

- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitution Submittal Procedure:
 - 1. Submit two copies of request for consideration. Limit each request to one proposed Substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed Product equivalence. Burden of proof is on proposer.
 - 3. Fully identify the substitutions effects on all facets of the Work and construction schedule.
 - 4. The Engineer will notify Contractor in writing of decision to accept or reject request.
 - 5. Accepted substitutions will be listed by addendum.

PART 2 PRODUCTS

2.01 UNIFORMITY

- A. For any type of similar equipment, i.e., motors, drive units, etc., provide equipment of the same manufacturer.
- B. Inform all subcontractors and suppliers of the selected manufacturers to ensure equipment uniformity.
- C. Obtain each separate type of product from the same manufacturer.

2.02 TOOLS

- A. For any equipment or equipment components requiring special tools, the Contractor shall supply the Owner with such tools to allow for the maintenance and removal/replacement of equipment components.

2.03 CONSUMABLES

- A. Provide Owner with all consumable items that are required during start-up and initial operation (90 days minimum) of all Project components including, but not limited to; coolant, fluids, oil, grease, other lubricants, filters, bulbs, batteries, etc.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all equipment in full compliance with the manufacturer's recommendations.
- B. Obtain services of qualified and approved factory representatives to install, check, and approve the installation of all equipment.

C. Service representative:

1. Present for the start-up and initial operation of all equipment.
2. Certify in writing that:
 - a. Equipment is properly installed and ready for operation.
 - b. Equipment properly aligned.
 - c. Direction of rotation checked.
 - d. Lubrication is proper.
 - e. Unit is free from undue stress from connecting pipe or anchorage.
 - f. Unit has operated at full load conditions.
 - g. Unit has operated in full compliance with the project specifications and the manufacturer's recommendations.

END OF SECTION

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SECTION 01 73 29
CUTTING AND PATCHING

PART 1 **GENERAL**

1.01 SUMMARY

- A. This Section includes:
 - 1. Requirements and limitations for cutting and patching of Work.
- B. Related Sections include:
 - 1. Section 01 11 00 – Summary of Work.
 - 2. Section 01 33 00 – Submittal Procedures.
 - 3. Section 01 61 00 – Common Product Requirements.
 - 4. Individual Product Specification Sections:
 - a. Cutting and patching incidental to Work of this Section.
 - b. Advance notification to other Sections of openings required in Work of those Sections.

1.02 SUBMITTALS

- A. Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate contractor(s).
- B. Include in request:
 - 1. Identification of Project.
 - 2. Location and description of affected Work.
 - 3. Necessity for cutting or alteration.
 - 4. Description of proposed Work and Products to be used.
 - 5. Alternatives to cutting and patching.
 - 6. Effect on work of Owner or separate contractor(s).
 - 7. Written permission of affected separate contractor(s).
 - 8. Date and time Work will be executed.

PART 2 **PRODUCTS**

2.01 MATERIALS

- A. Those required for original installation.

- B. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 61 00 – Common Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- B. After uncovering existing Work, assess conditions affecting performance of Work.
- C. Understand and become familiar with required coating systems, application requirements, and spatial concerns, issues, and dimensions required to perform the Work.
- D. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- B. Provide protection from elements for areas that may be exposed by uncovering Work.
- C. Maintain excavations free of water.
- D. Verify that all materials are clean and free from defects.

3.03 CUTTING

- A. Execute cutting and fitting to complete the Work.
- B. Uncover work to install improperly sequenced Work.
- C. Remove and replace defective or non-conforming Work.
- D. Remove samples of installed Work for testing, when requested.
- E. Coordinate openings in the Work for penetration of mechanical and electrical Work.
- F. Employ original installer of new Work to perform cutting for weather exposed and moisture resistant elements, and sight-exposed surfaces. Employ experienced personnel or original supplier for applying specialized coating systems.
- G. Cut rigid materials, masonry, prestressed concrete, and concrete using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

3.04 PATCHING

- A. Execute patching to complement adjacent Work.
- B. Fit Products together to integrate with other Work.
- C. Execute Work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- D. Employ original installer of new Work to perform patching for weather and moisture resistant elements, and sight-exposed surfaces.
- E. Restore Work with new Products in accordance with requirements of Contract Documents.
- F. Fit Work airtight and water tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- G. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- H. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
- I. Identify any hazardous substance or condition exposed during the Work to the Architect/Engineer for decision or remedy.

3.05 ALTERATION PROJECT PROCEDURES

- A. Materials: As specified in Product sections; match existing Products and Work for patching and extending Work.
- B. Employ skilled and experienced installer to perform alteration Work.
- C. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.
- D. Remove, cut, and patch Work in a manner to minimize damage and to provide means of restoring Products and finishes to original or specified condition.
- E. Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with a neat transition to adjacent finishes.
- F. Where new Work abuts or aligns with existing, provide a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.

- G. When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to Engineer for review.
- H. Where a change of plane of 1/4 inch or more occurs, submit recommendation for providing a smooth transition; to Engineer for review request instructions from Engineer.
- I. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing other imperfections.
- J. Finish surfaces as specified in individual Product Sections.

END OF SECTION

SECTION 01 75 00
STARTING AND ADJUSTING

PART 1 **GENERAL**

1.01 SUMMARY

A. Section includes:

1. Quality Assurance.
2. Scheduling.
3. Preparation.
4. Starting Systems.
5. Start-Up Period.
6. Adjusting.
7. Acceptance of Equipment and Systems.
8. Guarantee and/or Warranty Period.

B. Related Sections include:

1. Section 01 33 00 – Submittal Procedures.
2. Section 01 45 00 – Quality Control.
3. Section 01 77 00 – Closeout Procedures.
4. Section 01 78 23 – Operations and Maintenance Data.
5. Section 01 79 00 – Demonstration and Training.

1.02 QUALITY ASSURANCE

- A. Provide authorized and qualified manufacturer's representative to inspect, check, and approve equipment installation prior to start-up and to assist with demonstration testing.
- B. Authorized representative shall supervise placing equipment into operation.
- C. Prior to demonstration to OWNER and ENGINEER, provide written confirmation that systems have been tested, adjustments have been made, and equipment is ready for start-up demonstration.
- D. Provide access to equipment and systems. Operate systems at designated times and under conditions required.
- E. CONTRACTOR shall submit four (4) copies of written start-up report for each system or equipment item following each start-up.

1.03 SCHEDULING

- A. CONTRACTOR shall submit four (4) copies or a digital copy of preliminary start-up, and instruction schedule at least 15 calendar days prior to proposed dates. List times and dates for each system or equipment item. Include names of CONTRACTOR'S and subcontractors personnel, manufacturer, and/or authorized representative proposed to perform services. Provide documentation to verify their qualifications.
- B. CONTRACTOR shall coordinate scheduling of start-up. Scheduling of start-up shall be subject to approval of OWNER and ENGINEER.
- C. CONTRACTOR shall notify OWNER and ENGINEER of changes in scheduling at least five (5) days in advance prior to scheduled start-up of individual systems or equipment. Scheduling changes shall be subject to approval by OWNER and ENGINEER.

PART 2 **PRODUCTS**

NOT USED.

PART 3 **EXECUTION**

3.01 PREPARATION

- A. Confirm wiring to motors and controls are operational.
- B. Inspect equipment for cleanliness and remove or clean foreign matter.
- C. Lubricate each piece of equipment according to manufacturer's instructions. Check alignment, drive rotation, equipment speed, control sequence, and other conditions which may cause damage. Provide adjustment as required.
- D. Confirm that equipment is properly anchored and supported.
- E. Confirm wiring to motors and controls are operational.
- F. Confirm that auxiliary systems such as seal water and spray water systems are operational.
- G. Confirm that tests, meter readings, and specific electrical characteristics, including motor amperage agree with those specified.
- H. Confirm that control system is operation in automatic mode.
- I. Inspect hand and automatic valves, clean bonnets and stems, tighten packing glands to ensure no leakage. Adjust valves as necessary for proper operation.

Verify valve proper valve positioning for prior to start-up and testing of associated equipment.

- J. Provide instruments required for testing, adjusting, and balancing operations.
- K. All costs associated with starting, testing, adjusting, and balancing equipment including power and fuel costs shall be responsibility of the CONTRACTOR.

3.02

STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Engineer and Owner seven (7) days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable manufacturer's representative in accordance with manufacturer's instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01 33 00 that equipment or system has been properly installed and is functioning correctly.

3.03 START-UP PERIOD

- A. Following successful completion of demonstration testing per Section 01 79 00 – Demonstration and Training, the CONTRACTOR shall be responsible for the operation and control of new equipment and/or systems for a minimum period of 15 days.
- B. CONTRACTOR shall be responsible for making any changes, repairs, or replacements during this 15 day operating period.

- C. During the 15 day testing period, the CONTRACTOR shall provide supervisory personnel who fully understand the operation of the equipment. It is the intention that during this period, the OWNER'S personnel will become familiar with the operation and maintenance of the equipment or system.
- D. All costs associated with operating and maintaining the installed equipment and/or systems, including power and fuel costs shall be the responsibility of the CONTRACTOR.

3.04 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

3.05 ACCEPTANCE OF EQUIPMENT AND SYSTEMS

- A. Upon completion of training specified in Section 01 79 00 – Demonstration and Training, receipt of the final operation and maintenance manuals per Section 01 78 23 – Operations and Maintenance Data, receipt of the required start-up and demonstration testing reports, and following successful completion of the 15 day operating period, ENGINEER shall promptly review submittals of the manuals and reports.
- B. CONTRACTOR shall provide additional information or tests if required by the ENGINEER.
- C. Following review of the information, ENGINEER shall recommend approval of the equipment and acceptance of the installation to the OWNER. The OWNER shall provide in writing notice of acceptance of the equipment within a reasonable time after receipt of ENGINEER'S recommendation.
- D. Equipment placed into temporary operation prior to final completion of the project shall be readjusted and/or calibrated as required prior to final completion of the project.
- E. After equipment has been tested, adjusted, and accepted in writing by the OWNER, but before final acceptance of the entire project, the OWNER will assume operation and maintenance responsibilities for the equipment or systems, including power and fuel costs. The OWNER may place portions of the facility into operation prior to final acceptance of the entire project.

3.06 GUARANTEE AND/OR WARRANTY PERIOD

- A. The guarantee or warranty period for all equipment and/or systems will start from the date of written notice of final completion of the equipment and/or systems by the OWNER.

- B. There will be no exceptions to the start of the guarantee or warranty period.

END OF SECTION

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SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Closeout Procedures.
2. Substantial Completion.
3. Final Completion.
4. Certificate of Occupancy.
5. Final Cleaning.
6. Project Record Documents.
7. Spare parts and Maintenance Products.
8. Warranties and Bonds.
9. Maintenance Service.
10. Final Adjustment of Accounts.

B. Related Sections include:

1. Division 00 – General Conditions.
2. Division 00 – Supplemental General Conditions.
3. Section 01 31 13 – Project Coordination.
4. Section 01 50 00 – Temporary Facilities and Controls.
5. Section 01 75 00 – Starting and Adjusting.
6. Section 01 78 23 – Operation and Maintenance Data.

1.02 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.
- B. Provide submittals to Engineer that are required by governing or other authorities.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- D. Owner will occupy all portions of the Project.

1.03 SUBSTANTIAL COMPLETION

- A. Prior to substantial completion CONTRACTOR shall review Contract Documents for items which are not complete or need to yet be completed including submittal

of all manuals, and testing reports. CONTRACTOR shall make a list of incomplete work, a value of the incomplete work, and reasons why work is incomplete. CONTRACTOR shall complete all items required to be completed as part of substantial completion.

- B. CONTRACTOR shall provide a written notice to ENGINEER that the work, or specific portions of the work, is substantially complete and ready for review. If there are any items remaining to be corrected or completed CONTRACTOR shall submit a list of these items along with the notice of substantial completion. Along with the list of items the CONTRACTOR should provide a written explanation of why these items are not considered necessary for substantial completion.
- C. CONTRACTOR shall promptly complete the items required to meet substantial completion and submit a second notice of substantial completion to the ENGINEER.
- D. ENGINEER will review the work a second time to determine the status of substantial completion.
- E. When ENGINEER considers the project to be substantially complete, ENGINEER will prepare the preliminary certificate of substantial completion along with a substantial completion punch list of items to be completed prior to final payment. ENGINEER will deliver preliminary certificate and punch list to OWNER and consider any objections by the OWNER as provided in the Conditions of the Contract.
- F. Upon agreement by OWNER and ENGINEER of substantial completion and punch list items, ENGINEER will execute and deliver to the CONTRACTOR and OWNER a final certificate of substantial completion along with substantial completion punch list of items to be completed prior to final payment.
- G. A maximum of two (2) reviews of substantially complete work will be completed by ENGINEER and ENGINEER'S subconsultants for any one portion of work under the Contract. Should a third or subsequent reviews be necessary the following requirements will be met:
 - 1. OWNER will compensate ENGINEER for additional reviews.
 - 2. OWNER will deduct the amount of compensation paid to the ENGINEER for additional reviews from the payment to the CONTRACTOR.
 - 3. Compensation shall be at ENGINEER'S standard hourly rates plus actual cost of reimbursables.

1.04 FINAL COMPLETION

- A. Following substantial completion CONTRACTOR shall complete remaining work and items to be corrected as part of substantial completion punch list as well as final cleaning and transferring site to OWNER.
- B. When CONTRACTOR considers that all work is complete, CONTRACTOR shall provide written notice of final completion to ENGINEER.
- C. Following receipt of final completion certification, ENGINEER and ENGINEER'S subconsultants shall review the work to verify that the requirements for final completion have been met.
- D. Upon review of work for final completion ENGINEER will either request the CONTRACTOR to make closeout submittals or will notify CONTRACTOR that the work is not complete with a list of incomplete or defective work.
CONTRACTOR shall promptly take steps to correct all listed deficiencies and incomplete work before sending a second written notice of final completion certification to ENGINEER.
- E. If final completion was not met following first review, ENGINEER will review work a second time to determine if the requirements for final completion have been met.
- F. A maximum of two (2) reviews of final complete work will be completed by ENGINEER and ENGINEER'S subconsultants for any one portion of work under the Contract. If Owner or Engineer initiate a product or design change one (1) more submittal review can be approved without additional compensation.
Should a third or subsequent reviews be necessary the following requirements will be met:
 - 1. OWNER will compensate ENGINEER for additional reviews.
 - 2. OWNER will deduct the amount of compensation paid to the ENGINEER for additional reviews from the payment to the CONTRACTOR.
 - 3. Compensation shall be at ENGINEER'S standard hourly rates plus actual cost of reimbursables.
- G. When ENGINEER considers all work to be complete in accordance with the Contract Documents, ENGINEER shall request the CONTRACTOR to make closeout submittals.

1.05 CERTIFICATE OF OCCUPANCY

- A. In accordance with UT State Building Codes, when WORK is complete and ready for occupancy, CONTRACTOR shall contact local building official and request a final building code review for the purposes of obtaining a Certificate of Occupancy.

- B. CONTRACTOR shall, in accordance with Supplementary Conditions Article 14.07.a.2.e, submit copy of Certificate of Occupancy with final Application for Payment.

1.06 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains, and foreign substances, polish transparent and glossy surfaces, mop all floors.
- C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- D. Replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.07 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data, and Samples.
 - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling current and future reference by Owner and Engineer.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.

3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish first floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract drawings.
- G. Submit documents to Engineer with claim for final Application for Payment.

1.08 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Provide spare parts, maintenance, and extra Products in quantities specified in individual specification sections.
- B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.09 WARRANTIES AND BONDS

- A. Provide duplicate notarized copies.
- B. Execute and assemble transferable warranty documents from Subcontractors, suppliers, and manufacturers.
- C. Provide Table of Contents and assemble in D size three ring binders with durable plastic cover.
- D. Submit prior to final Application for Payment.
- E. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components during the warranty period.
- B. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- C. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

- D. Maintenance service shall not be assigned or transferred to any agent or Subcontractor without prior written consent of the Owner.

1.11 FINAL ADJUSTMENT OF ACCOUNTS

- A. CONTRACTOR shall submit a final statement of accounting to ENGINEER. Statement shall reflect all adjustments to the contract sum and include the following:
 - 1. Original contract sum.
 - 2. Additions and deductions resulting from:
 - a. All previous change orders
 - b. Allowances
 - c. Unit prices
 - d. Deductions for uncorrected work
 - e. Penalties and bonuses
 - f. Deductions for liquidated damages
 - g. Deductions for multiple reviews
 - h. Other adjustments
 - 3. Total contract sum as adjusted.
 - 4. Previous payments.
 - 5. Sum remaining due.
- B. ENGINEER will prepare a final change order, reflecting approved adjustments to the contract sum which were not previously made by change orders.

PART 2 **PRODUCTS**

NOT USED.

PART 3 **EXECUTION**

NOT USED.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 **GENERAL**

1.01 SUMMARY

A. Section includes:

1. Quality Assurance.
2. Format.
3. Contents of Each Volume.
4. Manual for Equipment and Systems.
5. Instruction of Owner's personnel.
6. Submittals.

B. Related Sections include:

1. Section 01 33 00 – Submittal Procedures.
2. Section 01 45 00 – Quality Control.
3. Section 01 77 00 – Closeout Procedures.

1.02 QUALITY ASSURANCE

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.03 FORMAT

- A. Prepare data in the form of an instructional manual. Arrange data in numerical format.

1. Binders:

- a. Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers.
- b. 2 inch maximum ring size.
- c. When multiple binders are used, correlate data into related consistent groupings.

2. Cover; Identify:

- a. Each binder with typed title OPERATION AND MAINTENANCE INSTRUCTIONS.
- b. Title of Project.
- c. Subject matter of contents.
- d. Volume number.
- e. Year of construction.

3. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment.

- B. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- C. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages. Folded paper should be unfoldable without removal from binder.
- D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers.
Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties.
 - e. Bonds.

1.04 CONTENTS OF EACH VOLUME

- A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Engineer, Subconsultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
- B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

- F. Warranties: Prepare and submit per Section 01 77 00 – Closeout Procedures.
- G. Bonds: Prepare and submit per Section 01 77 00 – Closeout Procedures.
- H. Digital Copy: Digital Copy on a flash drive shall be provided with all volume contents in electronic format or scanned to a portable document file (.pdf). The documents shall be placed as required under the appropriate tabs and labels as previously required for the flash drive. Each file shall be adequately labeled to identify the contents without opening the document.

1.05 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed. Refer to applicable Division 26 specification Sections.
- C. Include color coded wiring diagrams as installed. Refer to applicable Division 26 specification Sections.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.

- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage, and local sources of supply.
- N. Additional Requirements: As specified in individual Product specification sections.
- O. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
- P. Digital Copy: Digital Copy on a flash drive shall be provided with all volume contents in electronic format or scanned to a portable document file (.pdf). The documents shall be placed as required under the appropriate tabs and labels as previously required for the flash drive. Each file shall be adequately labeled to identify the contents without opening the document.

1.06 INSTRUCTION OF OWNER PERSONNEL

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.
- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.07 SUBMITTALS

- A. Submit electronic copies of preliminary draft or proposed formats and outlines of contents before Substantial Completion. Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit electronic copies of completed volumes fifteen (15) working days prior to final inspection. One (1) copy will be returned after final inspection, with

Engineer comments. Revise content of all document sets as required prior to final submission.

- D. Submit four (4) sets of revised final volumes in final form within ten (10) days after final inspection.
- E. Submit One (1) hard copy and One (1) digital copy sets of revised final volumes in final form within ten (10) days after final inspection.

PART 2 **PRODUCTS**

NOT USED.

PART 3 **EXECUTION**

NOT USED.

END OF SECTION

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SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 **GENERAL**

1.01 SUMMARY

- A. Section includes:
 - 1. Quality Assurance.
 - 2. Scheduling.
 - 3. Demonstration Testing.
 - 4. Equipment Training.
- B. Related Sections include:
 - 1. Section 01 45 00 – Quality Control.
 - 2. Section 01 75 00 – Starting and Adjusting.
 - 3. Section 01 77 00 – Closeout Procedures.

1.02 QUALITY ASSURANCE

- A. Provide authorized and qualified manufacturer's representative to inspect, check, and approve equipment installation prior to start-up and to assist with demonstration testing.
- B. Authorized representative shall supervise placing equipment into operation.
- C. Prior to demonstration to OWNER and ENGINEER, provide written confirmation that systems have been tested, adjustments have been made, and equipment is ready for start-up demonstration.
- D. Provide access to equipment and systems. Operate systems at designated times and under conditions required.
- E. CONTRACTOR shall submit one (1) hard copy and one (1) digital copy of written demonstration testing report following completion of demonstration testing for each equipment item. Report shall describe the test, test conditions, and result.

1.03 SCHEDULING

- A. CONTRACTOR shall submit one (1) hard copy and one (1) digital copy of demonstration testing and instruction schedule at least 15 calendar days prior to proposed dates. List times and dates for each system or equipment item. Include names of CONTRACTOR'S and subcontractors personnel, manufacturer, and/or authorized representative proposed to perform services. Provide documentation to verify their qualifications.

- B. CONTRACTOR shall coordinate scheduling of start-up, demonstration testing, and instruction of OWNER'S personnel by manufacturer's representatives. Scheduling of start-up, demonstration testing, and instructional activities shall be subject of approval of OWNER and ENGINEER.
- C. CONTRACTOR shall notify OWNER and ENGINEER of changes in scheduling at least five (5) days in advance prior to demonstration testing or instructional services for an individual systems or equipment. Scheduling changes shall be subject to approval by OWNER and ENGINEER.

PART 2 **PRODUCTS**

2.01 NOT USED.

PART 3 **EXECUTION**

3.01 DEMONSTRATION TESTING

- A. Upon completion of inspection, adjusting, and balancing per Section 01 75 00 – Starting and Adjusting; demonstrate that each separate piece of equipment of each system and related mechanical or instrumentation and control equipment operate in accordance with the requirements of the Contract Documents. Where no performance requirements are specified, demonstrate the equipment operates in accordance with the manufacturer's requirements and industry standards for the specific application.
- B. Demonstration tests shall confirm smooth operation, without excessive noise or vibration; equipment is responsive to manual and automatic controls; control and protective devices are properly set; and equipment will run on controlled or intermittent basis.
- C. Demonstrate all alarm and safety lockout systems for correct functioning with instrumentation and control. Each remote control point and alarm point shall be tested.
- D. In the event of demonstration test failure, the equipment shall be adjusted, repaired, or replaced subject to approval of the ENGINEER. Following adjustment, repairs, or replacement the equipment shall be demonstration tested again. All costs for adjustment, repairs, or replacement shall be the responsibility of the CONTRACTOR.
- E. All costs associated with the demonstration testing, including power and fuel costs shall be the responsibility of the CONTRACTOR.

3.02 EQUIPMENT TRAINING

- A. The CONTRACTOR shall provide competent personnel who fully understand the operation of the equipment and who are authorized by the manufacturer to instruct the OWNER on the operation and maintenance of each equipment item and/or system.
- B. Instruction and training shall take place following initial start-up, balancing, and testing of equipment or system. The instruction and training may take place prior to demonstration testing or during the 15 day operation period, but shall take place prior to acceptance of the installation by the OWNER.
- C. Training shall be of the on-the-job type, and shall cover all areas of control, operation, and maintenance.
- D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six (6) months.
- E. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- H. The amount of time required for instruction on each item of equipment and system is not less than that specified in individual sections.
- I. Taping of Training Sessions:
 - 1. The Owner reserves the right to use any types of audio/visual recording devices during start-up and training activities.

END OF SECTION

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DIVISION 03 CONCRETE

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SECTION 03 01 00
MAINTENANCE OF CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cleaning of concrete surfaces.
- B. Repair of exposed structural, shrinkage, and settlement cracks.
- C. Resurfacing of concrete surfaces having spalled areas and other damage.
- D. Patching of new concrete surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- B. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- C. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- D. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- E. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars; 2014.
- F. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2011.
- G. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2014.
- H. ASTM C928/C928M - Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Material for Concrete Repairs; 2013.
- I. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.

1.04 SUBMITTALS

- A. See Section

- B. Product Data: Indicate product standards, physical and chemical characteristics, technical specifications, limitations, maintenance instructions, and general recommendations regarding each material.
- C. Installer's Qualification Statement.
- D. Project Record Documents: Accurately record actual locations of structural reinforcement repairs and type of repair.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum of 3 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturers' instructions for storage, shelf life limitations, and handling of products.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

- A. Degreaser:
 - 1. Manufacturers:
 - a. Euclid Chemical Company; Euco Clean and Strip: www.euclidchemical.com/#sle.
 - b. SpecChem, LLC; Orange Peel: www.specchemllc.com.
- B. Detergent: Non-ionic detergent.
- C. Blasting Medium: As recommended by product supplier.

2.02 CEMENTITIOUS PATCHING AND REPAIR MATERIALS

- A. Manufacturers:
 - 1. BASF Corporation: www.buildingsystems.basf.com.
 - 2. SpecChem, LLC: www.specchemllc.com/#sle.
 - 3. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
 - 4. L&M Construction Chemicals, Inc.: www.lmcc.com.
 - 5. Five Star Products, Inc.: www.fivestarproducts.com.
 - 6. Substitutions: See Section 01 61 00 - Common Product Requirements.

- B. Cementitious Resurfacing Mortar: One- or two-component, factory-mixed, polymer-modified cementitious mortar designed for continuous thin-coat application.
 - 1. In-place material capable of withstanding freeze/thaw conditions (if required by the Engineer).
 - 2. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.
 - 3. Integral corrosion inhibitor.
 - 4. Color: As directed by Engineer.
- C. Cementitious Repair Mortar, Trowel Grade: One- or two-component, factory-mixed, polymer-modified cementitious mortar.
 - 1. In-place material resistant to freeze/thaw conditions.
 - 2. Mixed with water or latex type bonding agent in proportions as recommended by manufacturer.
 - 3. Integral corrosion inhibitor.
- D. Cementitious Repair Mortar, Form and Pour/Pump Grade: Flowable, one- or two-component, factory-mixed, polymer-modified cementitious mortar; in-place material resistant to freeze/thaw conditions.
 - 1. Mixed with water in proportions as recommended by manufacturer.
 - 2. Integral corrosion inhibitor.
- E. Cementitious Hydraulic Waterstop: Very fast setting, low slump, hand formable, and capable of stopping active water leaks; in-place material resistant to freeze/thaw conditions.
 - 1. Manufacturers:
 - a. SpecChem, LLC; SpecPlug or Super SpecPlug; www.specchemllc.com/#sle.
 - b. W. R. Meadows, Inc; Meadow-Plug or Meadow-Patch 5: www.wrmeadows.com/#sle.
 - c. BASF Corporation; MasterSeal 590: www.buildingsystems.basf.com
 - d. Substitutions: See Section 01 61 00 - Common Product Requirements.

2.03 EPOXY PATCHING AND REPAIR MATERIALS

- A. Manufacturers:
 - 1. Adhesives Technology Corporation: www.atcepoxy.com/#sle.
 - 2. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - 3. SpecChem, LLC: www.specchemllc.com/#sle.

4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Epoxy Repair Mortar: Epoxy resin mixed with aggregate and other materials in accordance with manufacturer's instructions for purpose intended; comply with pot life and workability limits.
 1. Products: As determined by the manufactures listed above.
 - a. Substitutions: See Section 01 61 00 - Common Product Requirements
- C. Epoxy Injection Adhesive:
 1. Products: As determined by the manufactures listed above.
- D. Epoxy Bonding Adhesive: Non-sag, two-component, 100 percent solids; recommended by manufacturer for purpose and conditions under which used.
 1. Non-Load-Bearing Applications: ASTM C881/C881M Type I, II, III, IV, or V, whichever is appropriate to application.
 2. Load-Bearing Applications: ASTM C881/C881M Type IV or V, whichever is appropriate to application.
 3. Products: As determined by the manufactures listed above.

2.04 ACCESSORIES

- A. Portland Cement: ASTM C150/C150M, Type II, grey.
- B. Sand: ASTM C33/C33M or ASTM C404; uniformly graded, clean.
- C. Water: Clean and potable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means acceptance of substrate.

3.02 CLEANING EXISTING CONCRETE

- A. Provide enclosures, barricades, and other temporary construction as required to protect adjacent work from damage.
- B. Clean concrete surfaces of dirt or other contamination using the gentlest method that is effective.
 1. Try the gentlest method first, then, if not clean enough, use a less gentle method taking care to watch for impending damage.

2. Clean out cracks and voids using same methods.
- C. The following are acceptable cleaning methods, in order from gentlest to less gentle:
1. Water washing using low-pressure, maximum of 100 psi, and, if necessary, brushes with natural or synthetic bristles.
 2. Increasing the water washing pressure to maximum of 400 psi.
 3. Adding detergent to washing water; with final water rinse to remove residual detergent.
 4. Steam-generated low-pressure hot-water washing.
 5. Abrasive blasting: Use only abrasive media that have been proven not to damage concrete by testing on mock-up.

3.03 CONCRETE SURFACE REPAIR USING CEMENTITIOUS MATERIALS

- A. Clean concrete surfaces, cracks, and joints of dirt, laitance, corrosion, and other contamination using method(s) specified above and allow to dry.
- B. Apply coating of bonding agent to entire concrete surface to be repaired.
- C. Fill voids with cementitious mortar flush with surface.
1. Fill all voids (honeycombs, rock pockets, bug holes, air bubbles, etc.) with any dimension larger than 1/4" in new concrete.
 2. Coordinate work with final coating and liner systems if applicable.
- D. Apply repair mortar by steel trowel to a minimum thickness of 1/4 inch over entire surface, terminating at a vertical change in plane on all sides.
- E. Trowel finish to match adjacent concrete surfaces.
- F. Damp cure for four days.

END OF SECTION

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SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete formwork.
- B. Concrete reinforcing
- C. Electrical Equipment pad.
- D. Controlled low strength material.
- E. Concrete reinforcement.
- F. Concrete curing.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
- B. ACI 301 - Specifications for Concrete Construction; 2020.
- C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000.
- D. ACI 305.1 - Specification for Hot Weather Concreting; 2014.
- E. ACI 306.1 - Standard Specification for Cold Weather Concreting; 1998.
- F. ACI 308.1 - Specification for Curing Concrete; 2011.
- G. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2019.
- H. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary; 2020.
- I. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- J. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.

- K. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- L. ACI PRC-347 - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- M. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- N. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- O. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete.
- P. ACI 305.1 - Specification for Hot Weather Concreting.
- Q. ACI 306.1 - Standard Specification for Cold Weather Concreting.
- R. ACI 308.1 - Specification for Curing Concrete.
- S. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
- T. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
- U. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- V. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2015a.
- W. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2015.
- X. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2013.
- Y. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.
- Z. ASTM C150/C150M - Standard Specification for Portland Cement; 2015.
- AA. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.
- BB. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.
- CC. ASTM C231/231M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- DD. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.

- EE. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- FF. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- GG. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes; 2001 (Reapproved 2012).
- HH. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2015.
- II. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.
- JJ. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014.
- KK. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2011.
- LL. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
- MM. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting; 2015.
- NN. ASTM E1155M - Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers (Metric); 2014.
- OO. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.
- PP. COE CRD-C 48 - Method of Test for Water Permeability of Concrete; 1992.
- QQ. COE CRD-C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.
- RR. Portland Cement Association (PCA).
- SS. PCA - Design and Control of Concrete Mixtures.

1.04 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.

- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
 - 1. For curing compounds, provide data on method of removal in the event of incompatibility with floor covering adhesives.
- C. Mix Design: Submit proposed concrete mix design. The mix design shall be specific to this project and conditions of placement. with a written request for acceptance. The data submitted shall include:
 - 1. Indicate proposed mix design complies with requirements of ACI SPEC-301, Section 4 - Concrete Mixtures.
 - 2. Indicate proposed mix design complies with requirements of ACI 318-Chapter 19 and Chapter 26
 - 3. Indicate proposed mix design complies with requirements of ACI 350, Chapter 4 and Chapter 5
 - 4. Fine and coarse aggregate gradations per ASTM C33.
 - 5. Method of determining the mix design proportions.
 - 6. Water to cementitious material ratio.
 - 7. Air content and unit weight.
 - 8. Compressive strength at 7 and 28 days per ASTM C 39.
 - 9. The proportions and types of all materials including admixtures.
- D. Test Reports: Submit report for each test or series of tests specified.
- E. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.
- F. Submit hot weather concreting procedures for concrete installed and/or cured during ambient temperatures over 80 degrees F. Submittal shall include specific procedures in conformance with ACI 305.1. Submittal shall include, but not be limited to, the following:
 - 1. Procedures for concrete delivery, including measuring and recording concrete temperatures at discharge.
 - 2. Methods for controlling temperature of reinforcement and embedded elements before and during placement.
 - 3. Procedures for measuring and recording concrete temperatures.
 - 4. Curing methods used to ensure proper design strength of concrete.
 - 5. Methods for preventing drying during dry and/or windy conditions.
- G. Submit cold weather concreting procedures for concrete installed and/or cured during temperatures described in ACI 306.1. Submittal shall include specific procedures in accordance with ACI 306.1. Submittal shall include, but not be limited to, the following:

1. Procedures for protecting subgrade from frost and accumulation of snow or ice on forms, reinforcement and other embedded members prior to placement.
 2. Methods for placing concrete to ensure no damage from cold weather effects.
 3. Methods for protecting concrete from cold weather and timing of addition/removal of said thermal protection.
 4. Procedures for measuring and recording concrete temperatures.
 5. Curing methods used to ensure proper design strength of concrete is met while following proper thermal protection procedures.
 6. Methods for ensuring concrete does not become damaged due to thermal shock upon removal of forms and/or thermal protection.
- H. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318
- B. Follow requirements of ACI 305.1 when concreting during hot weather.
- C. Follow requirements of ACI 306.1 when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI PRC-347 to provide formwork that will produce concrete complying with tolerances of ACI SPEC-117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
 1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
 2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces. Natural rock formations that maintain a stable vertical edge may be used as side forms.

2.02 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 1. Type: Deformed billet-steel bars.

2. Finish: Unfinished, unless otherwise indicated.

B. Reinforcement Accessories:

1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

A. Cement:

1. Portland Cement: ASTM C150/C150M, Type II - Moderate Portland type.
2. Blended Hydraulic Cement: ASTM C595/C595M, Type IL, Portland-Limestone.
3. Acquire all cement for entire project from same source or resubmit mill certificates if a different source is required.

B. Fine and Coarse Aggregates: ASTM C33/C33M.

1. Acquire all aggregates for entire project from same source or resubmit aggregate data if a different source is required.
2. Shale or deleterious content shall be no more than 0.5 percent for slabs and water bearing structures and 1 percent for all other concrete.

C. Fly Ash: ASTM C618, Class F.

D. Water: Per ASTM C1602 and "potable".

2.04 ADMIXTURES

A. Unless otherwise permitted, furnish admixtures from one manufacturer.

B. Do not use chemical admixtures that contain intentionally-added chlorides.

C. Air Entrainment Admixture: ASTM C260/C260M.

D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.

E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.

F. Accelerating Admixture: ASTM C494/C494M Type C.

G. Retarding Admixture: ASTM C494/C494M Type B.

H. Water Reducing Admixture: ASTM C494/C494M Type A.

- I. Shrinkage Reducing Admixture: ASTM C494/C494M, Type S.

2.05 ACCESSORY MATERIALS

- A. Controlled Low Strength Material (CLSM): Shall be a mixture of cement, Pozzolan, coarse and fine aggregate, admixtures, and water; mixed in accordance with ASTM C94 - Ready Mixed Concrete.
 - 1. Minimum Compressive Strength at 28 days:
 - a. Normal CLSM for pipeline shall be 100 psi.
 - b. Structural backfill or bearing CLSM shall be 750 psi.
 - 2. Composition: As determined by the ready mix supplier to achieve the minimum strength required.
 - 3. Total Air Content: 4 - 7 percent.
 - 4. Maximum Slump: 9 inches.

2.06 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
 - 1. Products:
 - a. Euclid Chemical Company ; EUCOBAR:
www.euclidchemical.com/#sle.
 - b. SpecChem, LLC; SpecFilm Concentrate or SpecFilm:
www.specchemllc.com/#sle.
 - c. Master Builders Solutions US LLC; MasterKure ER 50:
www.master-builders-solutions.com
 - d. W. R. Meadows, Inc; Evapre or Evapre-RTU:
www.wrmeadows.com/#sle.
- B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
 - 1. Products:
 - a. Dayton Superior Corporation; Safe Cure and Seal 1315 EF:
www.daytonsuperior.com/#sle.
 - b. SpecChem, LLC; E-Cure: www.specchemllc.com.
 - c. BASF Construction Chemicals; MasterKure CC 200WB.
- C. Coordinate all curing materials with coatings and floor finishing. Use water curing for all applications unless approved by the Engineer.
- D. Moisture-Retaining Sheet: ASTM C171.
 - 1. Curing paper, regular.

- 2. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.
- E. Polyethylene Film: ASTM D2103, 4 mil, 0.004 inch thick, clear.
- F. Water: Potable, not detrimental to concrete.

2.07 CONCRETE MIX DESIGN

- A. General:
 - 1. Prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301.
 - 2. 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.
- B. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.
- C. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
 - 1. For both methods, employ independent testing agency acceptable to Engineer for preparing and reporting proposed mix designs.
- D. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.
- E. Normal Weight Concrete for miscellaneous concrete elements, pipe supports, equipment pads, and housekeeping pads:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,500 psi.
 - 2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
 - 3. Water-Cement Ratio: Maximum 45 percent by weight.
 - 4. Total Air Content: As specified, determined in accordance with ASTM C173/C173M.
 - a. 5%-8% percent for concrete exposed to freeze / thaw conditions
 - 5. Maximum Aggregate Size: 3/4 inch.

2.08 MIXING

- A. General: In accordance with ACI 301, except as modified herein.
- B. On Project Site: Mix in drum type batch mixer, complying with ASTM C685. Mix each batch not less than 2 minutes.
- C. Transit Mixers: Comply with ASTM C94/C94M.
- D. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 BATCHING, MIXING, AND DELIVERY

- A. Concrete shall be furnished by an acceptable ready mixed concrete supplier, and shall conform to ASTM C94 except as indicated otherwise in this specification. The time from start of concrete mixing to completion of discharge from the truck shall not exceed 1-1/2 hours.
- B. Delivery Tickets A delivery ticket shall be prepared for each load of ready mixed concrete and a copy of the ticket shall be handed to Engineer by the truck operator at the time of delivery. Tickets shall indicate the name and location of Contractor, the project name, the mixture identification, the quantity of concrete delivered, the quantity of each material in the batch, the outdoor temperature in the shade, the time at which the cementitious materials were added, and the numerical sequence of the delivery.
- C. Mixing Water. Mixing water shall not be added in transit. Any amount of water withheld from the truck mixer shall be clearly indicated on the delivery ticket. Water added at the site shall not exceed the amount withheld, and shall not be added without oversight by Owner's on site inspector.
- D. The consistency of concrete shall be suitable for the placement conditions. Aggregates shall flow uniformly throughout the mass, and the concrete shall flow sluggishly when vibrated or spaded. The slump shall be kept uniform.

3.03 PREPARATION

- A. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

- B. Minimum Time between Abutting/Adjacent Sections:
 - 1. Foundation Slab Construction Joints: 7 days
 - 2. Concrete Elements not listed above: 48 hours

3.04 PLACING CONCRETE

- A. Place concrete in accordance with ACI PRC-304.
- B. Place concrete for floor slabs in accordance with ACI PRC-302.1.
- C. Notify Engineer not less than 24 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- G. Pumping systems used to convey concrete shall limit slump loss to not exceed 1 inch. The slump loss shall be determined by tests made at each end of the pumping system.
 - 1. Aluminum conveying devices shall be prohibited.
- H. Concrete shall be placed so that segregation does not occur. Downpipes or tremies shall be used to place concrete as close to its final destination as possible.
 - 1. Concrete's free fall should not exceed 5 feet.
- I. Concrete is to be placed in horizontal uniform layers not to exceed 24 inches. Consolidate concrete by mechanically vibrating.
- J. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.
- K. Evaporation Reducer Application:
 - 1. Use on flatwork when environmental conditions are anticipated to cause rapid drying of the concrete surface.

2. Spray onto surface of fresh concrete immediately after screeding to react with surface moisture.
 3. Reapply as needed to ensure a continuous moist surface until final finishing is completed.
- L. Hot Weather Concreting: Follow requirements of ACI 305.1, except as modified herein.
1. Maintain concrete temperature below 90 degrees F at time of placement.
 2. Follow procedure methods per Contractor submitted and approved Hot Weather Concreting plan
- M. Cold Weather Concreting: Follow requirements of ACI 306.1, except as modified herein.
1. Cold weather requirements shall apply when ambient temperature is or approach below 40 F.
 2. Follow procedure methods per Contractor submitted and approved Cold Weather Plan.
 3. Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. An independent testing agency, as specified in Section 01 45 00 - Quality Control , will inspect finished slabs for conformance to specified tolerances.
- B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
1. Exposed to View and Foot and Vehicle Traffic: F(F) of 25; F(L) of 20.
 2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15.
 3. Under Carpeting: F(F) of 25; F(L) of 20.
 4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25.
- C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.
- D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
- E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 CONCRETE SLAB FINISHING

A. General:

1. All slab finishes must be verified with Engineer prior to concrete placement. Finish to requirements of ACI PRC-302.1 and as follows.
2. Use manual, vibrating, or compacting screeds to place concrete level and smooth.
3. Cure concrete slabs as per Curing and Protection section.

B. Broomed Finish: Finish as specified for Steel Troweled Finish using a light-steel troweled finish. Complete finish by drawing hair broom lightly across surface in uniform direction.

1. Schedule:

- a. Exterior Surfaces: Exposed exterior slabs

3.07 CURING AND PROTECTION

A. Comply with requirements of ACI 308.1 . Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

1. Non-Water Containment Concrete: Contractor option with methods listed.

C. Formed Surfaces:

1. Method 1: Provide water curing methods as described for a minimum of seven (7) days.

- a. Curing to start as soon as forms have been removed. Keep continuously moist by saturated by the following methods.

- 1) Ponding: Maintain 100 percent coverage of water over areas, continuously.
- 2) Spraying: Spray water over floor slab areas and maintain wet.
- 3) Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.

2. Method 2: Application of approved curing compound.

- a. Curing compound to be applied immediately after the removal of concrete forms.
- b. Curing compound to be applied by means and application rate recommended by manufacturer.

- c. Not allowed at water containment concrete.
- 3. Method 3: Concrete forms to be left in place to provide protection for a minimum of seven (7) days.
 - a. Exposed surfaces to be maintained as described by Method 1.
- D. Surfaces Not in Contact with Forms:
 - 1. Method 1: Provide water curing methods as described for a minimum of seven (7) days.
 - a. Curing to start as soon as forms have been removed. Keep continuously moist by saturated by the following methods.
 - 1) Ponding: Maintain 100 percent coverage of water over areas, continuously.
 - 2) Spraying: Spray water over floor slab areas and maintain wet.
 - 3) Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
 - 2. Method 2: Application of approved curing compound.
 - a. Curing compound to be applied immediately after removal of forms.
 - b. Curing compound to be applied by means and application rate recommended by manufacturer.
 - c. Not allowed at water containment concrete.
 - 3. Method 3: Water curing as described in Method 1 for a minimum of three (3) days followed by the application of Moisture-Retainings sheets for a minimum of five (5) days.
 - a. Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.

3.08 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 00 - Quality Control.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- E. Unless otherwise specified, sample concrete for testing from point of delivery.

1. Pumped Concrete: Sample concrete for testing from point of placement .
- F. Compressive Strength Tests: ASTM C39/C39M. For each test, in accordance with ASTM C31, mold and cure five concrete test cylinders.
1. Sample frequency: Obtain test samples for every concrete pour greater than five (5) cubic yards. Additionally obtain test samples for every 50 cu yd of concrete placed.
 2. Test cylinders to be tested at the following age: One (1) at 7 days, three (3) at 28 days, and one (1) at 54 days.
 3. Additional concrete cylinders to be tested at days other than those specified above must be requested by the Contractor. Costs of additional cylinders will be by the Contractor.
- G. Cold Weather Concreting:
1. During cold weather concreting conditions, cast compressive strength cylinders for field curing as follows.
 - a. Obtain six (6) additional test cylinder for field curing.
 2. Field cured specimens shall be in addition to specimens cast for lab testing.
 3. Protect field cured specimens from weather and place under same protection provided for concrete structure.
 4. Field cured specimens to be kept in same protective environment as representative concrete structure to determine if specified strength has been achieved.
 5. Test cylinders in accordance with ASTM C39/C39M and ASTM C31/C31M.
- H. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
- I. Perform one air test for each set of test cylinders taken. Air content shall be tested per ASTM C231. Concrete tested for air shall be sampled for at the point of discharge where pumping is being used.
- J. Take and record temperature of all concrete tested in accordance with ASTM C1064.
- K. Maintain records of concrete placement. Record date, location, time truck left plant, time truck started emptying, time truck empty, quantity, air temperature, and test samples taken.
- L. Test completed water bearing structures as specified in Section 03 96 90. Patch and repair completed structures as required to meet specified requirements.

3.09 PATCHING AND REPAIR

- A. Allow Engineer to observe concrete surfaces immediately upon removal of forms. Patch imperfections as specified in Section 03 01 00 per manufacturer's instructions. Areas patched prior to Engineer's observation and concurrence will require removal of patching material to allow observation. Costs associated with removal and replacement shall be paid by the Contractor.

3.10 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Engineer and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. If concrete tests fail to meet required strength, additional tests will be directed by Engineer. If additional tests fail to confirm required strength, the Contractor shall pay for all the cost of Work to replace defective concrete. Contractor shall pay for all additional tests and engineering services.
- D. Repair or replacement of defective concrete will be determined by the Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- E. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

3.11 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.
- B. Do not allow construction loads in excess of final design loads on any structural concrete members without shoring and possible re-shoring.

END OF SECTION

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DIVISION 06 WOOD, PLASTICS, AND COMPOSITES

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SECTION 06 71 00
FIBERGLASS REINFORCED GRATING AND STRUCTURAL SHAPES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Perimeter closure.
- B. FRP pultruded floor grating.
- C. FRP structural shapes and fabrications.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.

1.04 PERFORMANCE REQUIREMENTS

- A. The design of FRP products including connections shall be in accordance with governing building codes and standards as applicable.
- B. Design Live Load:
 - 1. Uniform Live Load: 100 lb/sq ft minimum.
 - 2. Concentrated Load: 300 lb minimum.
- C. Maximum Allowable Deflection Under Live Load: 1/360 of span; size components by single support design.
- D. Maximum Spacing Between Bars: As specified or per delegated design.
- E. Structural members shall be designed to support all applied loads. Deflections in any direction shall not be more than L/240 of span for structural members. Connections shall be designed to transfer the loads.

1.05 SUBMITTALS

- A. See Division 01 for submittal procedure
- B. Product Data: Provide span and deflection tables.
- C. Shop Drawings: Indicate details of component supports, openings, perimeter construction details, and tolerances.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- D. Samples: Submit two samples, 12x12 inch in size illustrating surface finish, color, and texture.
- E. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- F. Manufacturer's Installation Instructions: Indicate special requirements for opening and perimeter framing.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design gratings and plates under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State of Utah
- B. Static coefficient of friction for non-slip finishes shall be tested to exceed 0.80 COF for both wet and dry conditions.
- C. FRP Materials:
 - 1. Product must meet NSF / ANSI 61
 - 2. The material covered by these specifications shall be furnished by an ISO-9001:2000 certified manufacturer of proven ability who has regularly engaged in the manufacture and installation of FRP systems.
 - 3. Substitution of any component or modification of system shall be made only when approved by the Engineer.
 - 4. Fabricator Qualifications: Firm experienced in successfully producing FRP fabrications similar to that indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.
 - 5. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

PART 2 PRODUCTS

2.01 MANUFACTURERS - FRP GRATINGS AND FABRICATIONS

- A. Enduro Systems Inc.; Composite Products Division.
- B. Seasafe, Inc.; a Gibraltar Industries company.
- C. Strongwell Corporation.
- D. Fibergrate Composite Structures
- E. Mona Composites
- F. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. FRP products shall be manufactured using a pultruded process utilizing polyester resin with flame retardant and ultraviolet (UV) inhibitor additives. A synthetic surface veil shall be the outermost layer covering the exterior surface.
- B. After fabrication, all cut ends, holes and abrasions of FRP shapes shall be sealed with a compatible resin coating.
- C. All exposed surfaces shall be smooth and true to form, consistent with ASTM D4385.

2.03 ACCESSORIES

- A. Fasteners and Saddle Clips: Stainless steel:
- B. Perimeter Closure: Of same material and finish of grating.
- C. FRP Support Member Fasteners: Stainless steel threaded rod with approved epoxy adhesive system.

2.04 FRP FABRICATIONS

- A. Pultruded Glass-Fiber-Reinforced Gratings and Decking: Bar gratings and FRP decking assembled from components made by simultaneously pulling glass fibers and extruding thermosetting plastic resin through a heated die under pressure to produce a product without voids and with a high glass-fiber content.
 - 1. Configuration: As indicated on the drawings.
 - 2. Color: Grey.
 - 3. Traffic Surface: Applied abrasive finish.
 - 4. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating

gratings. Add additional support around openings with added frames and supports.

5. Removable grating openings: Provide grating for removal as indicated on drawings. Add additional support around openings with added frames and supports.
6. Hold down clamps shall be type 316L stainless steel hold downs as provided by FRP manufacturer. Use two (2) at each support with a minimum of four (4) per panel.

B. Frames and Supports for Glass-Fiber-Reinforced Plastic Gratings and Decking:

1. Structural members are to be designed and supplied to adequately support grating at perimeter and intermediate support locations. Structural support layout, member size, and orientation shall be designed and determined by the supplier.
2. Support member connection to foundation shall be designed and supplied as required.
3. Fabricate from glass-fiber-reinforced plastic shapes of sizes, shapes, and manufacturer's standard profiles indicated and as necessary to receive gratings. Miter connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
4. Unless otherwise indicated, use shapes made from same resin as gratings.
5. Structural members may be designed using stainless steel or aluminum

2.05 FASTENERS

A. General: Provide stainless steel fasteners for exterior use, where built into exterior walls. Select fasteners for the type, grade, and class required.

B. Standards: All fasteners shall comply with:

1. Drilled-In Expansion Anchors: Expansion anchors complying with Fed. Spec. FF-S-325, Group VIII (anchors, expansion, [non-drilling]), Type I (internally threaded tubular expansion anchor); and machine bolts complying with Fed. Spec. FF-B-575, Grade 5.
2. Lock washers: Helical spring type carbon steel, Fed. Spec. FF-W-84.
3. Bolts, nuts, machine screws, plain washers, masonry anchors, lock washers, and concrete anchors: Stainless Steel, ASTM A193.
4. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).

2.06 FINISHES

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated on drawings.
- B. Verify that opening sizes and dimensional tolerances are acceptable.
- C. Verify that supports are correctly positioned.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and according to the Project Documents.
- B. Field cut as needed to fit installation. All field cutting shall be in accordance with the manufacturer's recommended procedures.
- C. Attach all gratings as removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.
- D. Store FRP gratings indoors or otherwise protect them from unnecessary exposure to ultraviolet radiation.
- E. All field-cut or damaged areas of FRP gratings shall be sealed with sealing resin according to the manufacturer's recommendations.

3.03 DISSIMILAR MATERIALS

- A. Where dissimilar metals are in contact, the metals shall be kept from direct contact by use of isolation material.

3.04 TOLERANCES

- A. Conform to NAAMM MBG 531.
- B. Maximum Variation From Top Surface Plane of Adjacent Sections: 1/8 inch
- C. Replace defective or damaged slip-resistant metal fabrications as directed by engineer.

END OF SECTION

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DIVISION 07 THERMAL AND MOISTURE PROTECTION

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SECTION 07 54 00
THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Adhered system with thermoplastic roofing membrane.
- B. Insulation, flat and tapered.
- C. Vapor retarder.
- D. Flashings.

1.02 REFERENCE STANDARDS

- A. ASTM D6878/D6878M - Standard Specification for Thermoplastic Polyolefin-Based Sheet Roofing; 2021.
- B. NRCA (RM) - The NRCA Roofing Manual; 2025.
- C. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.03 SUBMITTALS

- A. See Division 01 for submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
- C. Manufacturer's qualification statement.
- D. Warranty Documentation:
 - 1. Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
 - 2. Submit installer's written verification that installation complies with warranty conditions for waterproof membrane.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

1.05 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

- B. System Warranty: Provide manufacturer's system warranty agreeing to repair or replace roofing that leaks or is damaged due to wind or other natural causes.
 - 1. Warranty Term: 20 years.
 - 2. For repair and replacement include costs of both material and labor in warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Thermoplastic Polyolefin (TPO) Membrane Roofing Materials:
 - 1. GAF; EverGuard TPO 60 mil: www.gaf.com/#sle.
 - 2. Versico Roofing Systems; VersiWeld TPO: www.versico.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ROOFING - UNBALLASTED APPLICATIONS

- A. Thermoplastic Membrane Roofing: One ply membrane, fully adhered, over insulation.
- B. Acceptable Insulation Types - Constant Thickness Application: Any of types specified.
 - 1. Minimum 2 layers of cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, or composite board.
 - 2. Bottom layer of cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, composite, or cellular glass board covered with single layer of cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, or composite board.
- C. Acceptable Insulation Types - Tapered Application: Any of types specified.
 - 1. Tapered polyisocyanurate, perlite, or extruded polystyrene board.
 - 2. Tapered polyisocyanurate, perlite, extruded polystyrene, or cellular glass board covered with uniform thickness cellulose, perlite, molded polystyrene, polyisocyanurate, glass fiber, extruded polystyrene, or composite board.
 - 3. Uniform thickness cellulose, perlite, composite, polyisocyanurate, extruded polystyrene, molded polystyrene, glass fiber, or cellular glass board covered with tapered polyisocyanurate, extruded polystyrene, or perlite board.

2.03 MEMBRANE ROOFING AND ASSOCIATED MATERIALS

- A. Membrane Roofing Materials:

1. TPO: Thermoplastic polyolefin (TPO) complying with ASTM D6878/D6878M, sheet contains reinforcing fabrics or scrims.
 - a. Thickness: 60 mil, 0.060 inch, minimum.
 2. Sheet Width: Factory fabricated into widest possible sheets.
 3. Color: White.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Flexible Flashing Material: Same material as membrane.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION - WOOD DECK

- A. Verify flatness and tightness of joints in wood decking; fill knot holes with latex filler.

3.03 INSTALLATION, GENERAL

- A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
- B. Do not apply roofing membrane during cold or wet weather conditions.
- C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
- D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.04 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

- A. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
- B. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- C. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- D. Do not install more insulation than can be covered with membrane in same day.

3.05 INSTALLATION - MEMBRANE

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Fully Adhered Application: Apply adhesive to substrate. Fully embed membrane in adhesive except in areas directly over or within 3 inches of expansion joints. Fully adhere one roll before proceeding to adjacent rolls.
- D. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
 - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Coordinate installation of roof drains and sumps and related flashings.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Owner will provide testing services, and Contractor to provide temporary construction and materials for testing in accordance with requirements.
- C. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.

3.07 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Remove bituminous markings from finished surfaces.
- C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- D. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

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DIVISION 09 FINISHES

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SECTION 09 90 10

PIPELINE COATINGS AND LININGS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. This Section covers the work necessary to apply external coating and internal mortar lining on steel or ductile iron pipe, field coating of joints, and field repair of coating damage, complete.
- B. Steel pipe will be provided with either a tape wrap with cement mortar overcoat or polyurethane coating system.
- C. Mortar coated steel pipe shall be provided where specifically shown on the Drawings.
- D. All exposed steel pipe, fittings, and appurtenances in vaults and above grade shall be coated in accordance with Section 09 96 00 High Performance Coatings.
- E. Hand applied tape wrap shall not be allowed under any conditions.

1.02 RELATED SECTIONS:

- A. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
- B. The following Sections are related to the Work described in this Section. The list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to determine that the completed Work complies accurately with the Contract Documents.
 - 1. Section 01 33 00 Submittal Procedures.
 - 2. Section 09 96 00 High Performance Coatings
 - 3. Section 26 42 10 Galvanic Cathodic Protection

1.03 SUBMITTAL REQUIREMENTS

- A. Contractor submittals shall be made in accordance with Section 01 33 00 Submittal Procedures.
 - 1. Shop Drawings: Catalog cuts and other information for all products proposed. Provide copy of approved coating system submittals to the coating applicator. Provide copies of coating manufacturer application procedures and repair procedures. Provide copies of the heat shrink sleeve manufacturer's application procedures.
 - 2. Quality Control Submittals: Furnish the following:
 - a. Applicator's Experience with list of references substantiating compliance.
 - b. Coating manufacturer's certification stating the applicator meets or exceeds their coating application requirements and recommendations.
 - c. Coating manufacturer shall provide a copy of the manufacturer's coating application quality assurance manual.

- d. If the manufacturer of field-applied coating differs from that of the shop applied primer, provide written confirmation from both manufacturers that the two coating materials are compatible.
- e. Provide copies of all Certified Test Reports for all coating and lining testing.
- f. Provide certification from the coating manufacturer that the coatings are being applied in accordance with the coating manufacturer's specifications at the start of coating and/or lining operations. Additionally, submit reports from monthly follow-up site visits from coating manufacturer that the coatings are being applied in accordance with the coating manufacturer's specifications based upon the monthly site visits.

1.04 QUALITY ASSURANCE

- A. Coating Applicator's Experience and Certification:
 - 1. Coating Application Company and coating application supervisor (Certified Applicator) shall have a minimum of 5 years' experience applying the specified coating system.
 - 2. Coating application personnel, who have direct coating application responsibility, shall have a minimum of 2 years practical experience in application of the indicated coating system.
 - 3. Coating applicator shall be certified by the coating manufacturer as an approved applicator.
- B. Coating and/or lining manufacturer's technical representative shall be present for a minimum of 3 days technical assistance and instruction at the start of coating and/or lining operations within the shop. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.
- C. Coating and/or lining manufacturer's technical representative shall be onsite for 3 working days, minimum, at the start of each construction season to inspect coating application and procedures in the field. During this visit, the technical representative shall observe surface preparation and coating application and conduct tests of the coating to insure conformance with application instructions, recommended methods, and conditions.
- D. Coating and/or lining manufacturer shall include 8 hours per month of field or shop coating technical support when requested by the Engineer.
- E. Technical representative shall provide a written report to the Engineer for each visit. Report shall include copies of test data collected, description of observations, and all recommended corrective actions. Report shall be submitted within 5 working days after the visit. When deemed necessary by the Engineer, work will not be permitted to proceed until the recommended corrective actions have been implemented. After all corrective recommendations have been completed; the manufacturer representative shall return and certify that the application complies with the manufacturer's coating application recommendations.
- F. Additional visits by the manufacturer's representative shall be made at sufficient intervals during surface preparation and coating or lining as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions, and as may be necessary to resolve problems attributable to, or associated with, manufacturer's products furnished for this project.

1.05 ABBREVIATIONS

The following abbreviations are used in this Section:

Abbreviations	
MDFT	Minimum Dry Film Thickness
mil	Thousandths of an Inch

1.06 DEFINITIONS

- A. Manufacturer's Representative: Employee of coating manufacturer who is factory trained and knowledgeable in all technical aspects of their products and systems. Sales representatives are not acceptable as a technical representative unless written authorization from the coating manufacture is provided which states the sales representative has full authority to act on the behalf of the coating manufacturer.
- B. Specials Fittings and Connections: Defined as any joint of pipe with turnout, blowoff, fabricated tee, cross, wye, manhole, mitered angles or elbows, crotch plates, butt straps, or fabricated pipe that cannot be coated using through put or straight pipe coating application equipment and the following specific items:
 - 1. All pipe joint sections entering a structure.
 - 2. Pipe joints with weld lead pass through holes.
- C. SHOP: A shop is defined as a permanent, fully enclosed building with a concrete floor that can be power washed with a potable water supply and floor drains.

1.07 REFERENCE STANDARDS

- A. This specification section recognizes AWWA, NACE, and SSPC standards as minimum industry standards and are referenced for purpose of conformance, except where modified in this section. The requirements of this specification section have been written to a higher design standard with the intent of achieving a long term coating performance. The applicable provisions of the following standards shall apply as if written here in their entirety:

1.08 SPECIAL WARRANTY REQUIREMENTS

- A. The Contractor and coating applicator shall warrant to the Owner and guarantee the Work under this Section against defective workmanship and materials for a period of 2 years commencing on the date of final acceptance of the Work.
- B. This warranty shall be in addition to the prime CONTRACTOR's warranty that covers repair of all defective work, including linings and coatings

1.09 OBSERVATION OF WORK

- A. The Contractor shall give the Owner Representative a minimum of 14 days' advance notice of the start of any work to allow scheduling for shop or field observation. Provide Owner Representative a minimum 3 days' notice for actual start of surface preparation and coating application work.
- B. Provisions shall be made to allow Owner's representative full access to facilities and appropriate documentation regarding coating application.
- C. Observation by the Owner's representative or the waiver of observation of any particular portion of the Work shall not be construed to relieve the Contractor of his responsibility to perform the Work in accordance with the Contract Documents.

- D. Materials shall be subject to testing for conformance with this Section as the Owner's representative may determine, prior to or during incorporation into the Work.
- E. Perform such work only in the presence of Engineer, unless Engineer grants prior approval to perform such work in his absence.

PART 2 - MATERIALS

2.01 GENERAL

- A. Exterior and interior pipe and fitting surfaces shall be prepared and coated in accordance with referenced standards, written directions of the coating or lining manufacturers, and the Specifications, whichever is more stringent.
- B. Coatings and linings will be stored, handled, and applied per manufacturer's written directions.
- C. Pipeline coating or lining shall be the product of a single manufacturer. Product substitutions during the Project will not be permitted.

2.02 CONTRACTOR FURNISHED TEST EQUIPMENT

- A. Contractor shall provide the following coating test equipment for field testing of pipe for holidays:
 - 1. Holiday Test Equipment:
 - a. Elcometer Model D236, 0 to 30 kV high voltage tester or approved equal.
 - b. External Pipe rolling spring probe, sized for the Project pipe diameter.
 - c. Right Angle Wire Brush Probe, 20 inches or larger.
 - d. Telescopic probed extension handle, 2- to 4-foot length range.
- B. Equipment to be turned over to the Owner upon completion of the Work. Equipment shall be in full working condition with all manuals, cases, and accessories supplied with equipment or required to be provided.

2.03 EXTERIOR SHOP-APPLIED COATINGS

- A. General:
 - 1. Buried steel pipe, consisting of straight lengths of pipe, shall be coated with the following coating systems.
 - a. Polyethylene Tape Wrap with Cement Mortar Overcoat (AWWA C214 and C205)
 - b. Polyurethane Coatings for Interior and Exterior of Steel Water Pipe and Fittings (AWWA C222)
 - 2. Buried steel pipe specials, fittings, and other complex shapes, shall be coated with the following coating systems.
 - a. Plural Component Polyurethane Coatings (AWWA C222)
 - 3. Ancillary steel and ductile iron pipe shall be coated in accordance with AWWA C215, except as modified herein, at the Contractors option.
 - 4. Steel pipe specified to receive a cement mortar overcoat shall be shop-coated with the required coating system and a 3/4-inch thick, minimum, cement mortar overcoat as specified herein.

5. Pipe that is atmospherically exposed shall be shop primed as specified herein and Section 09 90 00 PAINTING AND COATING.
6. Buried dielectrically coated pipe and fittings passing through a concrete structure wall or floor shall be coated for a minimum of four-inches beyond the interior wall or floor surface.

B. Polyethylene Tape Wrap

1. Pipe shall be coated with an 80 mil (nominal), tape-coating systems applied in accordance with AWWA C214, except as modified herein.
 - a. Primer: Polyken 1019, 1027, 1029, or as recommended by the coating manufacturer.
 - b. Weld Stripe Tape: Polyken 931 (no backing), 25 mils nominal, 4-inches wide minimum.
 - c. Inner Wrap: Polyken 989 YGIII, 20 mils nominal, corrosion protection layer.
 - d. Middle Wrap: Polyken 955 YGIII, 30-mils nominal, mechanical protection layer.
 - e. Outer Wrap: Polyken 956 YGIII, 30 mils nominal, mechanical protection layer.
 - f. Surface Preparation:
 - 1). Steel Pipe: SSPC-SP5, White Metal blast, 2.5 mils blast profile, minimum.
2. Tape Coating:
 - a. Tape layers shall have adhesive for the full width of the tape. Adhesive shall have the ability to stick to itself and to the proceeding tape layer or pipe.
 - b. Each layer shall be a different color or shade with the outer layer white.
 - c. Outer wrap shall have sufficient ultraviolet (UV) inhibitors to resist above grade exposure for a minimum of 12 months or the proposed storage and construction time, whichever is greater.
 - d. Tape width shall be 12-inches maximum. Wider tape will be conditionally allowed if the coating applicator can demonstrate that proper tensioning can be maintained and mechanical wrinkling prevented throughout the coating application. If at any time during the pipe fabrication tape quality becomes inconsistent with a wider tape, the Engineer can require the remainder of the pipe to be coated using the maximum specified tape width.

C. Plural Component Polyurethane:

1. General: Plural component, polyurethane coating system (referred to as a polyurethane system) shall be applied in accordance with AWWA C222, and as modified herein.
2. Shop Surface Preparation:
 - a. Steel pipe: SSPC-SP5, White Metal blast, 3.5-mil angular profile, minimum, or as required by the manufacturer, whichever is greater using standardized testing procedures such as Press-O-Film and micrometer.
3. Shop Applied Coating Requirements:
 - 1). Self-priming, plural component, 100 percent solids, non-extended polyurethane, suitable for burial or immersion. Extended polyurethane coatings will not be acceptable. Polyurethane shall be manufactured within 30 days of shipping to application facilities, and polyurethane shall not be taken from previous inventory.

- b. One coat, 35 mils total dry film thickness, minimum, or as required to meet the holiday and coating defects limits specified in this Section.
- c. Shall be one of the following products, subject to review and acceptance of submitted product performance reports:
 - 1). Protec II, Futura Coatings, Hazelwood, Missouri.
 - 2). Chemthane 2265, Chemline, Inc., St. Louis, Missouri.
 - 3). Polyclad 777, Carboline, St. Louis, Missouri.

D. Exterior Coating for Exposed Steel Pipe:

- 1. All atmospherically exposed or vault piping and appurtenances shall be shop primed with the coating system as specified in Section 09 90 00 PAINTING AND COATING.
- 2. Manufacturer of shop-applied primer shall be coordinated with field application to provide a completed system by a single manufacturer. Engineer approval of a coating system with two or more coating manufacturers will require written approval from all coating manufacturers as to compatibility and acceptance under warranty.

E. Cement Mortar Coating or Overcoat

- 1. Apply cement mortar coating system on steel pipe and fittings in accordance with AWWA C205, except as modified herein.
- 2. Cement mortar overcoat shall be applied over a dielectric coating system on steel pipe in accordance with AWWA C205, except as modified herein.
- 3. Holdback:
 - a. Mortar overcoat shall be held back of dielectric coating a minimum of 3 inches for overlap of field applied joint coating onto dielectric coating system.
- 4. Shop Applied Coating System:
 - a. Cement: Conform to ASTM C150, Type II.
 - b. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
 - c. Cement mortar mixture shall consist of 1 part cement to not more than 3 parts aggregate.
 - d. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities. Use no more than 4-1/2 gallons of water per sack of cement.
- 5. Cement mortar coating: Nominal 1-inch thick coating with permitted tolerance of $\pm 1/4$ -inch.

2.04 INTERIOR SHOP-APPLIED LININGS

- A. Cement Mortar Lining shall be in accordance with Section 02570 – WELDED STEEL PIPE AND FITTINGS or as specified below:
- B. Cement Mortar Lining:
 - 1. Clean and cement mortar line steel pipe and fittings in accordance with AWWA C205.
 - 2. Cement: Conform to ASTM C150, Type II.

3. Shop applied cement mortar lining shall be uniform in thickness over the full length of the pipe joint.
4. Aggregate shall be silica sand or other aggregate that is not subject to leaching. Conform to ASTM C33.
5. Water for cement mortar: Clean and free from organic matter, strong alkalis, vegetable matter, and other impurities.

C. Liquid Applied Epoxy Coating:

1. Provide liquid epoxy primer and lining in all cement mortar lined metallic pipe at insulating joints for a minimum of two pipe diameters on each side of the insulated joint.
2. Epoxy coatings shall be NSF approved coatings suitable for potable water contact in accordance with ANSI/NSF Standards 60 and 61.
3. Epoxy shall be applied over the cement mortar lining where specified for the pipeline lining material.
4. Prepare the cement mortar lining by abrasive blasting to remove all laitance and provide and provide a surface profile equivalent to 80 grit sandpaper.
5. Cement mortar shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing.
6. Mortar lining shall be dry when epoxy lining is applied.

2.05 SPECIALS, FITTINGS, AND CONNECTIONS

- A. Coating and lining application for special sections, connections, and fittings for steel or ductile iron pipe shall conform to coating system and application requirements as specified in this Section.
- B. Polyurethane is the only coating system allowed for specials, fittings, and pipes with outlets. Internal mortar lining shall be applied to all specials, fittings, and pipes with outlets. All specials, fittings, and pipes with outlets shall also be shop coated with a cement mortar armor coat.
- C. Specials, fittings, and connections shall be defined as any pipe section with turnouts for blowoffs, interconnects, any valve, or other appurtenances; tees; crosses; wyes; laterals; manholes; mitered angles or elbows; and pipes which require special fabrication that prevents mechanical production application of the specified coating system from end to end of pipe joint.
- D. In addition to the items listed as specials, the following items shall also be considered as specials:
 1. Pipe joints with pass through holes.
- E. Hand applied tape coatings will not be permitted on any specials, fittings, connections, and elbow fittings.
- F. Specials, fittings, and connections shall be externally coated with polyurethane coating system applied over the entire fitting. Fabrication cutting and welding is not allowed on coated surfaces. No hybrid coating system, such as tape and polyurethane combination, will be allowed.

2.06 FIELD APPLIED COATING SYSTEMS

- A. General
 1. Miscellaneous Metals

- a. All buried miscellaneous metal components installed on the pipeline and that is supplied bare or with a shop coating system that is not equal to the specified pipeline coating shall be coated in the field with one of the following coating systems.
 - (1) Petrolatum or Wax Tape Coating
 - (2) Heat Shrink Sleeve
 - b. Miscellaneous metal components shall include, but not be limited too, all exposed metals surfaces, including bolts, couplings, flanges, valves, adapters, pipe spools, and other miscellaneous metal components.
 - c. Coating system applied shall conform to the manufacturer's requirements and shall be applied in accordance with the application requirements of the coating system.
 - d. Filler material shall be applied for all field applied coating systems to provide sufficient transition at welds and other dimensional changes to prevent all tenting or voids under the applied coating, regardless of manufacturer's recommendations.
2. Pipe Joints General:
- a. Pipe joints shall be field coated after pipe assembly with one of the following coating systems as specified.
 - (1) Petrolatum or wax tape coating system
 - (2) Heat Shrink Sleeves.
 - b. Steel pipe joints shall be coated with a heat shrink coating, unless specified otherwise.
 - c. Ductile iron push-on bell and spigot joints may be heat shrink sleeve coated, provided filler mastic is used to prevent tenting or voids under the sleeve.
 - d. Joints of cement mortar overcoated tape wrap steel pipe do not require cement mortar overcoated after application of the specified field applied joint coating.
 - e. Flanges, couplings, ductile iron pipe joints, and all bolted or threaded joints are classified as complex shapes and shall be wax tape coated with filler material to ensure completed encapsulation and filling of all bolts, crevices, gaps, and dimensional transitions as required to prevent tenting of the finished coating.
- B. Petroleum or Wax Tape Coating:
1. Application:
 - a. Coating shall be applied in accordance with AWWA C217, except as modified herein.
 - b. Wax tape coatings shall be field applied on all buried couplings, thrust restraint rods and brackets, valves, and on joints, fittings, or irregular shapes or complex configurations that could cause tenting of heat shrink coating system.
 - c. Provide wax filler material for all complex shapes, bolts, flanges, gaps, and dimensional transitions to completely fill and encapsulate the metal surfaces and prevent tenting of the applied tape coating.
 - d. Buried wax tape coated surfaces shall be overcoated with plastic shrink film as recommended by the manufacturer.
 - e. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.
 - f. Use sand backfill to protect wax coating from damage.
 2. Surface Preparation: SSPC-SP11 Power Tool to Bare Metal or SSPC-SP10, near white abrasive blast.
 3. Coating System:

- a. Primer: petroleum or petrolatum wax, suitable for wet surfaces.
- b. Filler Material:
 - (1) Filler materials shall be petroleum or petrolatum wax sealer/filler with closed cell plastic filler
 - (2) Provide filler material to fill and smooth all irregular surfaces, such that no tenting or voids remain under the applied wax tape.
- c. Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40 mils thick
- d. Outer Wrap: PVC or tape suitable for application to inner tape.
- 4. Manufacturers: Wax tape coating system shall be as manufactured by:
 - a. Denso North American
 - b. Trenton
 - c. Or approved equal.

2.07 EXTERIOR FIELD JOINT COATING

- A. Pipe joints shall be field coated after pipe assembly in accordance with AWWA C205, C216, or C217, whichever is applicable and as specified herein.
- B. Field joint coating shall be compatible with the shop-applied coating system and provided by the same manufacturer or a manufacturer approved by the pipe coating manufacturer.
- C. All joints on pipe coated with polyurethane coating system and tape wrapped pipe shall be coated with a heat shrink coating material.
- D. Buried flexible couplings shall be coated with wax tape or heat shrink coating system.
- E. Field joint coating materials shall be as follows or an approved equal.
 - 1. Heat Shrink Sleeves:
 - a. Filler Material:
 - 1). Provide filler material for all push-on, flange, and coupling type joints and at all changes in outside diameter are greater than 1/8 inch, unless manufacturer's requirement is more stringent than this specification.
 - 2). Filler material shall adhere to the pipe and heat shrink sleeve. Size and type shall be as recommended by the sleeve manufacturer for type of pipe and joint.
 - 3). Filler mastic for joints subject to weld after backfill shall exceed 500 F melt point temperature.
 - 4). Filler material shall be applied in a manner, and of sufficient thickness, that no tenting or voids remain under the heat shrink sleeve.
 - 5). Filler material shall be Canusa Aqua Seal SG79 or Raychem Covalence 939 Filler.
 - b. Joint Coating:
 - 1). Heat shrink, cross-linked polyolefin wrap or sleeve with a mastic sealant, 85-mils minimum nominal thickness, suitable for pipeline operating temperature, as recommended by the manufacturer, and shall meet the requirements of AWWA C216.
 - 2). Provide standard recovery sleeve for welded or bell and spigot steel pipe joints. High recovery sleeves shall be provided for flange joints and coupling style joints.

- 3). Width of heat shrink sleeves shall be sufficient to overlap existing coating 2-inches minimum. Overlap on tape coated steel pipe shall be based on a sequential 2-inch wide step from outer wrap to middle wrap to inner wrap.
 - 4). Contractor shall consider sleeve shrinkage during installation and joint profile in determining sleeve width required. Overlapping of two or more heat shrink sleeves to achieve the necessary width on pipe joints will not be permitted without Engineer approval.
 - 5). Sleeve shall meet requirements for "Weld After Backfill" when allowed and approved by Engineer.
 - c. Holdback Primer: As specified in this Section.
 - d. Heat Shrink Sleeve: The outer sleeve shall be Canusa Aqua Shield AQW-HS or Raychem-Covalence Water Wrap-WAB. For "Weld After Backfill", a 6" underlay sleeve shall be centered over the weld area prior to the installation of the outer sleeve. The underlay sleeve shall be Aqua Shield AQW-WAB or equivalent Raychem Covalence.
2. Wax Tape Coating:
- a. Apply coating in accordance with AWWA C217, except as modified herein.
 - b. Wax tape coatings shall be field applied on all buried flexible joints, thrust restraint rods and brackets, and on joints, fittings, or irregular shapes or complex configurations that are not suited for the use of heat shrink coating systems and are not cement overcoated.
 - c. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.
 - d. Provide filler material to fill and smooth all irregular surfaces, such that no tenting or voids remain under the applied wax tape.
 - e. Use sand backfill or flowable fill to protect wax coating from damage.
 - f. Coating System:
 - 1). Surface Preparation: SP11 Power Tool to Bare Metal.
 - 2). Primer: Petroleum or petrolatum wax.
 - 3). Filler Material: Filled Petroleum or petrolatum wax sealer/filler with closed cell plastic filler.
 - 4). Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40 mils thick.
 - 5). Outer Wrap: PVC or tape suitable for application to inner tape.
 - g. Wax tape coating system shall be as manufactured by:
 - 1). Denso North American.
 - 2). Trenton.
 - 3). Approved equal.
3. Cement Mortar Coating or Overcoat:
- a. Joints of cement mortar coated steel pipe shall be mortar coated as specified herein after application of the specified joint coating materials, where applicable.

- b. Polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape.
 - 1). 100 percent closed-cell
 - 2). Chemically inert, insoluble in water, resistant to acids, alkalis, and solvents.
 - 3). Manufacturer and Product: Dow Chemical Company; Ethafoam 222.
 - c. Fabric Backing:
 - 1). Cut and sewn into strips wide enough to overlap shop-coated areas by 4 inches on either side.
4. Strips shall have slots for steel strapping on outer edges.

2.08 INTERIOR FIELD JOINT COATING

A. Mortar Lining:

- 1. After the backfill has been completed to final grade, the interior joint recess shall be filled with grout. The grout shall be tightly packed into the joint recess and troweled flush with the interior surface. Excess shall be removed.
- 2. At no point shall there be an indentation or projection of the mortar exceeding 1/16 inch.
- 3. With pipe smaller than 24 inches in diameter, before the spigot is inserted into the bell, the bell shall be daubed with grout. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.

2.09 REPAIR OF COATINGS AND LININGS

A. General:

- 1. Coating or lining repair materials shall be compatible with the shop-applied coating or lining system and shall be approved by the coating or lining manufacturer.
- 2. Coating repair materials shall be as required for the coating system and repair classification as defined in this Section.
- 3. All major repairs on pipe coated with polyurethane coating system shall be repaired using heat shrink sleeves as specified for field joint coating in accordance with C216, except as modified herein.
- 4. Minor coating repairs for polyurethane coated or exposed pipe shall be as specified herein.

B. Coating Repair Materials:

- 1. Heat Shrink Sleeves (major repair):
 - a. Filler Mastic: Provide mastic filler to fill tape void as required.
 - b. Full Wrap Coating: Cross-linked polyolefin wrap with a mastic sealant, 85-mil thickness nominal, suitable for pipeline operating temperature, sleeve material recovery as recommended by the manufacturer. Sleeve length shall provide a nominal 3 inches overlap onto intact pipe coating.
 - c. Manufacturer's: Canusa Aqua Shield AQW-HS or Raychem (Polyken) Covalence WaterWrap –WAB.

2. Heat-Applied Patches (minor repair):
 - a. Heat applied adhesive, polyolefin backed, mastic coated tape, 12-inch maximum size.
 - b. CRP patch as manufactured by Canusa, PERP patch as manufactured by Raychem (Polyken), or equal.
- C. Polyurethane Coating:
1. Polyurethane coating system repair shall be in accordance with the coating manufacturer's recommended procedures.
 2. Coating material for minor repairs shall be single use kits or other mix ratio controlled packages of slow set polyurethane coating material similar to the existing coating.
 3. Major repairs in the shop will be completed using the coating material specified for the coating or the lining. Coating shall be reapplied using plural component spray equipment by a manufacturer certified coating applicator.
 4. Major repairs in the field shall be completed using heat shrink sleeves as specified this section.
 5. Pinhole holidays or adhesion test coating repairs shall be with minor repair coating material specified or Protal 7125 Fast Cure Epoxy.
- D. Exposed Pipe Coating System: Touch-up repair all damage to the primer and/or intermediate coats with the specified coating system prior to final coating of the pipeline in accordance with Section 09 90 00 PAINTING AND COATING.

2.10 HOLDBACK CORROSION PROTECTION

- A. Primer for corrosion protection of cutbacks or holdbacks shall be compatible with the specified joint coating system and high heat resistant requirements, where applicable.
- B. Approved holdback primers are:
 1. Tnemec Omnithane – Suitable for all joints, except joints subject to high heat resistant joints
 2. Tnemec 90E-92 Ethyl Silicate Inorganic Zinc Primer – suitable for all joints, including high heat resistant joints
 3. ICI Devoe Cathacoat 304V Ethyl Silicate Inorganic Zinc Primer – suitable for all joints including high heat resistant joints
 4. Polyken Tape Primers – Not allowed
- C. Primer shall not result in running or melting of the coating or cause toxic fumes when heated during welding of joints.
- D. Application and thickness of holding primer shall be in accordance with the coating manufacturer's recommendations, but shall not impair the clearances required for proper joint installation.
- E. Holdback requirements shall be as specified this section.

PART 3 EXECUTION

3.01 ENVIRONMENTAL LIMITATIONS

A. General:

1. Products shall comply with federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposure.
2. Comply with applicable federal, state, and local, air pollution and environmental control regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, and coating application.
3. Do not perform abrasive blast cleaning whenever the relative humidity exceeds 85 percent, whenever surface temperature is less than 5°F above the dew point of the ambient air.
4. Do not apply coatings when:
 - a. Surface and ambient temperatures exceed the maximum or minimum temperatures recommended by the coating manufacturer or the Specifications,
 - b. In dust or smoke-laden atmosphere, blowing dust or debris, damp or humid weather, or under conditions that could cause icing on the metal surface.
 - c. For epoxy coatings or linings when it is expected that surface temperatures would drop below 5°F above dew point within 4 hours after application of coating.
 - d. Whenever relative humidity exceeds 85 percent for polyurethane coating application.
5. Where weather conditions or Project requirements dictate, Contractor shall provide and operate heaters and/or dehumidification equipment to allow pipe surfaces to be abrasive blasted and coated as specified and in accordance with the manufacturers coating application recommendations.
6. Work activities can be restricted by the Engineer until adequate temperature and humidity controls are in place and functioning within the environmental limits specified.
7. Coating applicator shall provide a monitoring system approved by the coating manufacturer that constantly records pipe and coating conditions during coating application. Recorded monitoring parameters shall include pipe temperature, line speed, surface preparation, holiday test and other parameters applicable to the type of coating.

B. Temperature Control:

1. In cold weather or if moisture collects on the pipe, preheat pipe to a temperature between 45°F and 90°F, or 5°F above dew point, whichever is greater.
2. When temperatures are above or below the coating manufacturer's recommended application temperatures, the Contractor will provide temperature controls as necessary to permit Work to precede within the manufacturer's temperature limitations.
3. Provide tenting, insulating blankets, baffles, or bulkheads as required to zone and control heating or cooling effectiveness.
4. Heating shall be with indirect fired heaters that do not increase humidity levels within the work area. Heaters shall be sized for the area to be heated.

- C. Dehumidification (if required to meet specified environmental parameters for surface preparation and coating application):
1. Dehumidification shall be operated in a manner that prevents all condensation or icing throughout surface preparation, coating application, and coating cure.
 2. Reblasting of flash rusted metal surfaces or removal of damaged coatings, as a result of equipment malfunction, shutdown, or other events that result in the loss of environmental control, will be at the sole expense of the Contractor. Cleaned metal surfaces subject to flash rusting shall be cleaned to the same cleanliness as prior to the flash rust formation and shall be approved by the Engineer.
 3. Contractor shall monitor ambient temperature, humidity, dew point temperature, and pipe surface temperature (work area only) both outdoors and within the work area at the start, midpoint, and end of each work shift, minimum, but not greater than 5 hours between measurements.
 4. Daily environmental condition monitoring and maintenance of the equipment shall be documented in writing and posted near the equipment for review by the Engineer.
 5. If the required environmental conditions cannot be maintained throughout the coating process, the Contractor will be required to provide the following:
 - a. Contractor shall provide and operate desiccant dehumidification equipment to maintain environmental conditions for 24 hours a day during abrasive blasting and coating application and cure. Liquid, granular, or loose lithium chloride drying systems will not be acceptable.
 - b. Contractor shall provide dehumidification equipment sized to maintain dew point temperature 5°F or more below surface temperature of metal surfaces to be cleaned and coated. System shall provide ventilation within the environmentally controlled areas to meet the following requirements:
 - 1). Two air exchanges per hour, minimum.
 - 2). Maintenance of personnel exposure limits (PEL) at 50 percent of OSHA PEL limits for all chemicals used in the performance of the Work.
 - 3). Maintenance of lower explosive limits (LEL) to less than 50 percent of the most volatile solvent used in the performance of the Work.
 - c. Dehumidification equipment shall also provide ventilation at a minimum of 0.75 air exchanges per hour within all non-accessible work areas for worker protection or as required for maintaining PEL and LEL explosive limits as defined herein, whichever is more stringent.
 - d. Dehumidification equipment type, size, air flow, and power requirements shall be designed by a qualified company knowledgeable in dehumidification equipment, and its operation based on Project requirements and anticipated seasonal weather conditions for the Project schedule. Design to include evaluation of existing conditions, humidity, and temperature, proper air exchange requirements, ventilation requirements, ducting requirements for adequate air flow, and any other issues necessary to achieve the specified performance and environmental conditions throughout the duration of the Project.
 - e. Contractor to submit written recommendations from dehumidification Subcontractor for enclosure work area size, bulkhead venting, duct work for each bulkhead section, any secondary ventilation requirements for coating cure, dust collection equipment CFM requirements, and drying requirements

for blast hose compressed air necessary to maintain environmental control as specified herein.

- f. At a minimum, work area shall be separate into surface preparation work zones, coating application zones, and coating cure zones.
- g. Dehumidification Subcontractor shall either operate the equipment or provide training to Contractor on the proper operation and setup of dehumidification equipment. Dehumidification Subcontractor shall provide a technical representative on-Site for a minimum of two 8 hour days to insure proper operation of the equipment, achievement of desired environmental control, and to insure Contractor can properly setup, operate, monitor, and maintain the equipment.

3.02 SURFACE PREPARATION

A. General:

- 1. Inspect and provide substrate surfaces prepared in accordance with the Specifications and the printed directions and recommendations of coating manufacturer whose product is to be applied.
- 2. Visible oil, grease, dirt, and contamination shall be removed in accordance with SSPC-SP1, solvent cleaning.
- 3. Surface imperfections such as metal slivers, burrs, weld splatter, gouges, or delaminations in the metal shall be removed by filing or grinding prior to abrasive surface preparation.
- 4. Protect prepared pipe from humidity, moisture, and rain. All flash rust, imperfections, or contamination on cleaned pipe surface shall be removed by reblasting.
- 5. Priming and coating of pipe shall be completed the same day as surface preparation.

B. Weld Surface Preparation

- 1. Requirements:
 - a. Spray applied coating systems do not require weld grinding.
 - b. Welds on tape wrap coated pipe shall be either ground flush or a weld stripe tape applied over the weld, at the pipe fabricator's option, unless otherwise specified.
- 2. Weld Grinding:
 - a. Under the weld grinding option, welds higher than 1/32 inch above pipe surface shall be ground to a tolerance of +1/32 inch to 0-inch above the pipe surface as measured on the lowest side of the weld.
- 3. Weld Stripe Tape:
 - a. Weld stripe tape will be applied to primed metal.
 - b. Tape will either have no polyethylene backing or will be double sided adhesive tape to permit adhesion of the inner corrosion protection layer to the weld stripe tape.
 - c. Apply tape with a pressure roller to fully conform the tape to the weld surface.
 - d. Adhesion of the weld stripe tape shall be as specified for the coating system.

C. Salt Contamination Removal

1. All bare or shop coated or primed surfaces that will be coated in the field shall be pressure washed with potable water not greater than 8 hours before coating application, including pipeline joints.
 2. Residual soluble salt contamination (SSC) shall be tested as specified under Quality Control testing.
 3. Surfaces to be Abrasive Blasted:
 - a. Surfaces that fail the soluble salt contamination test prior to abrasive blasting shall be cleaned by pressure washing and/or abrasive blasting and retested.
 - b. Surfaces that fail the SSC test after surface preparation shall be recleaned and/or abrasive blasting and retested.
 - c. Surfaces which still exceed the specified SSC level after recleaning shall be subject to determination by the Engineer if additional work will be required.
 - d. Contractor shall remove all surface rust caused by SSC testing in accordance with SP-11, Power Tool to Bare Metal or abrasive blasting to the specified cleanliness.
 4. Existing or Shop Primed Surfaces:
 - a. All previously coated surfaces shall be tested for SCC prior to application of additional coats.
 - b. Surfaces exceeding the specified SSC level after pressure washing shall be subject to additional cleaning as determined by the Engineer.
 - c. Any coating applied before SCC testing is completed and accepted by the Engineer will be rejected and removed.
- D. Steel Surface Preparation:
1. Surface preparation of steel pipe shall be in accordance with SSPC surface preparation standards utilizing the degree of cleanliness specified for the coating system to be applied or as specified herein, whichever is more stringent.
 2. Grit and/or shot abrasive mixture and gradation shall be as required to achieve the degree of cleanliness and coating adhesion specified.
 3. Pipe cleaned by abrasive blasting with recyclable steel grit and/or shot or other abrasive shall be cleaned of debris and spent abrasive in an air wash separator.
 4. Surface shall have a sharp angular surface profile of the minimum depth specified.
 5. After abrasive blasting surfaces and before coating application, the metal surface shall be cleaned of residual dust to a minimum of Grade 2 per ISO Standard 8502-3, Test for the Assessment of Surface Cleanliness.
 6. Work shall be performed in a manner that does not permit the cleaned metal surface to rust back or flash rust.
 7. Rust back or flash rust shall be fully removed with the steel surface cleanliness equal to the metal surface cleanliness prior to rust back or flash rusting. Determination of the equivalent surface cleanliness shall be at the Engineer's discretion.
- E. Ductile Iron Surface Preparation
1. Provide ductile iron pipe without the manufacturer's standard asphaltic varnish coating.

2. Round off or bevel all sharp edges (bell shoulders, spigot ends, fitting edges, etc.) to smooth transition by grinding. For some coating and lining applications (internal pipe linings, etc.), additional grinding may be necessary prior to abrasive blasting in accordance with coating manufacturer's recommendations.
3. Surface preparation cleanliness shall be similar to the equivalent SSPC surface preparation grade as specified with consideration that color of blasted ductile iron pipe will not match that of abrasively blasted steel. Properly cleaned ductile or cast iron will be a near-gray color.
4. Use SSPC SP grades as a surface preparation guide only for percentage cleanliness required and surface contaminants removed. Abrasive cleaning shall remove the same percentage of all surface contaminants (including tightly adhered annealing scale) as specified in the SSPC standard specified.
5. Avoid over blasting, high nozzle velocities, and excessive blast times. Abrasive blasting of cast or ductile iron shall be performed in a manner to avoid lifting or exfoliating of the metal surface. Pipe manufactured using the deLavaud Process (dual spray) are highly susceptible to exfoliation of the metal surface. Any surface exfoliation shall be removed by grinding followed by reblasting.
6. The entire surface area shall be abrasive blasted. No tight rust stains shall be allowed.

F. Concrete Surface Preparation:

1. Cement Mortar or Concrete Cure:
 - a. Cement mortar linings shall be allowed to cure for a minimum of 15 days prior to surface preparation and coating application or 7 days with steam curing.
 - b. Concrete surfaces shall be cured 30 days.
2. Preparation Requirements:
 - a. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent, or other suitable cleaning methods.
 - b. Clean concrete using mechanical or chemical methods for the degree of cleaning specified for the coating system in accordance with SSPC SP-13, Surface preparation of Concrete.
 - c. Abrasive blast to remove all laitance and provide a surface profile equivalent to 80 grit sandpaper.
 - d. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to coating.
3. Inspection:
 - (1) Concrete Soundness: Determined using scratching or hammer impact methods as defined in SSPC SP-13.

G. Moisture Content: Moisture shall be tested as Specified in SSPC SP-13 and shall not exceed the moisture content recommended by the coating manufacturer.

3.03 SHOP -APPLIED COATING SYSTEMS

A. Tape Wrap Coating

1. Applicator shall provide a monitoring system approved by the tape manufacturer that constantly records pipe and tape conditions during coating application. Recorded monitoring parameters shall include, but not be limited too, pipe temperature; line speed, primer and tape roll body temperature, and tape tension.

2. Pipe surface temperature shall be between 45 and 120 degrees and 5 degrees above dew point, whichever is greater.
 3. Tape roll temperature shall be in accordance with the manufacturer's recommendations, but shall not be less than 55 degrees for the inner wrap and 65 degrees for the outer wraps.
 4. Apply a uniform coat of primer as recommended by the manufacturer without skips, runs, or sags. Allow to properly dry prior to applying the tape as required by the tape manufacturer and as necessary to achieve maximum tape adhesion. Rug type application will not be allowed.
 5. If welds are not ground flush, apply a weld stripe tape to longitudinal or spiral pipe welds prior to application of the inner wrap.
 6. Tape layers shall be applied continuously with the use of hydro-tension tape stands. Tension shall be maintained between the manufacturer's minimum and maximum tension recommendations or as required to achieve approximately 2.0 percent reduction in tape width.
 7. Inner tape wrap shall adhere tightly to the pipe surface. Coating shall be 100 percent adhering to the metal surface and shall not have any visible damage, wrinkles, voids, disbondment, contamination, or holidays.
 8. Tape coating adhesion testing shall be performed on the pipe as specified this section.
 9. Holiday testing shall be conducted on the inner layer tape prior to proceeding with subsequent tape layers. All holidays detected shall be primed and patch using coating repair procedures specified herein.
 10. Perform coating and lining repairs as specified in this section.
- B. Polyurethane Coating or Lining:
1. Applicator Qualifications:
 - a. Equipment will be certified by the coating manufacturer to meet the requirements for material mixing, temperature control, application rate, and ratio control for multi-part coatings.
 - b. Equipment not meeting the written requirements of the coating manufacturer shall be rejected for coating application until repairs or replacement of the equipment is made to the satisfaction of the Engineer.
 - c. Personnel responsible for the application of the coating system shall have certification of attendance at the coating manufacturer's training class within the last 3 years. The certified applicator shall be present during all coating application work and shall have responsibility for controlling all aspects of the coating application.
 2. Pipe surface temperature shall be between 50°F and 100°F or 5°F above dew point, whichever is greater.
 3. Coating application shall be performed in an environmentally controlled shop area that meets or exceeds the written environmental application requirements of the coating manufacturer. Application in outdoor conditions will not be acceptable without adequate environmental shelter, environmental controls, and/or dehumidification.
 4. Coating adhesion and holidays testing shall be tested as specified in this Section.

5. Coating manufacturer shall provide the Engineer a copy of the manufacturer's coating application quality assurance manual prior to beginning coating application. Strict conformance to the requirements of the manual will be required. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating.
 6. Unacceptable Coating Application:
 - a. Coating applied under improper environmental conditions will be rejected.
 - b. Pipes that exceed the allowable quantity of coating defects, regardless of size or cause, shall be rejected.
 - c. Coating which fails the adhesion or holiday testing as specified in this Section shall be rejected.
 - d. Pipe coating that is subject to off ratio application, blistering, or is not applied in conformance with the coating manufacturer's written instructions or recommendations shall be rejected.
 7. Rejected coating shall be removed from the full length of the pipe to bare metal and reapplied using proper application methods in accordance with the quality assurance manual and the requirements of the Specifications.
 8. Perform coating and lining repairs as specified in this Section.
- C. Cement Mortar and Overcoat Coatings
1. Steel pipe shall have a cement mortar coating applied in accordance with AWWA C205, except as modified herein.
 2. Dielectrically coated steel pipe, when specifically required, shall have a cement mortar overcoat applied over the dielectric pipe coating in accordance with AWWA C205, except as modified herein.
 3. Cement Mortar Coating:
 - a. Reinforcement:
 - 1). For pipe and specials smaller than 48 inches in diameter, reinforce coating with spirally-wound No. 12 gage steel wire spaced at 1 inch centers or with No. 14 gage steel wire at 1/2 inch centers positioned approximately in center of mortar coating.
 - 2). For pipe and specials 48 inches in diameter and larger, reinforce coating with 2 layers of spirally-wound No. 12 gage wire spaced at 1 inch centers or with No. 14 gage steel wire spaced at 1/2 inch centers positioned at the third points of mortar coating.
 - 3). Lap ends of reinforcement strips 4 inches and tie or loop free ends to assure continuity of reinforcement.
 - a). 48 inches in diameter and larger.
 - 4). All steel wire reinforcement placed in the mortar coating shall be electrically isolated from the pipe. Electrical isolation will be tested using high voltage spark test by the manufacturer prior to shipment to the project site. Provide certification that electrical isolation of reinforcement wire from steel pipe.
 - b. Special Fittings:
 - 1). Special fittings shall be polyurethane coated as specified.
 - c. Coating Defects:

- 1). Coating defects shall be repaired as specified in AWWA C205, except as specified this section.
4. Cement Mortar Overcoat:
- a. Cement mortar overcoat dielectrically coated steel pipe as specified in AWWA C205, except mortar coating shall be applied over exterior pipe coating.
 - b. Mortar coating shall be held back 3 inches, minimum, behind dielectric coating system cut back at joints. Holdback shall be increased with extruded polyethylene coating as required to maintain the minimum overlap specified for joint coating application, where specifically required to be cement mortar over coated.
 - c. Coating Defects:
 - 1). Cracking in the mortar "armor" coat less than 1/8-inch in width will be acceptable.
 - 2). Disbondment of the cement coating over a dielectric coating system should be anticipated and will not be grounds for repair or rejection of the pipe.
 - 3). Losses of cement mortar coating due to impact, movement, or shipping damage shall be repaired in accordance with C205

3.04 EXTERIOR COATING HOLDBACK

- A. Dielectric coating holdbacks shall be straight and cut through the full thickness of the coating.
- B. Dielectric coating cutbacks shall be completed in a manner that permits field coating of joints in accordance with the manufacturer's recommendations and as specified herein.
- C. Dielectric coating holdbacks shall be as required for pipe joints as listed below. Pipe manufacturer may adjust holdback limits as required for special joint assemblies, and with consideration for the joint coating provided and joint welding requirements:

Holdbacks	
Tape Wrap Coating	
Push-on joint, spigot	4 inches, minimum
Push-on, bell	Flush with bell end
Welded, spigot	3 inches, minimum
Welded, Bell	4 inches, minimum
Polyurethane	
Push-on joint, spigot	1 inch before centerline gasket
Push-on, bell	Flush with bell end
Welded, spigot	3 inches, minimum
Welded, Bell	4 inches, minimum

- D. Dielectric Coating Holdback Corrosion Protection:

1. Holding primer for corrosion protection of cutbacks or holdbacks shall be compatible with the specified joint coating system and weld after backfill requirements, when applicable.
2. Approved holdback primers are:
 - a. Tnemec Omnithane: Suitable for all joints, except joints subject to weld after backfill.
 - b. Tnemec 90E-92 Ethyl Silicate Inorganic Zinc Primer: Suitable for all joints, including weld after backfill joints.
 - c. ICI Devoe Cathacoat 304V Ethyl Silicate Inorganic Zinc Primer: Suitable for all joints including weld after backfill joints.
 - d. Polyken or Other Tape Primers: Not allowed.
3. Holdback coating shall prevent corrosion of prepared pipe ends for duration of storage and construction, and shall be recommended for buried exposures.
4. Primer shall not result in running or melting of the coating or cause toxic fumes when heated during weld after backfill joints.
5. Application and thickness of holding primer shall be in accordance with the coating manufacturer's recommendations, but shall not impair the clearances required for proper joint installation.
6. Primer application on spigot end of field welded pipe shall be held back 1 to 2 inches from the end of the spigot or as necessary to prevent toxic fumes during field welding.
7. Any corrosion within the holdback areas shall be abrasively blasted to near white metal in accordance with SP10 or power tool cleaned to bare metal in accordance with SP11 prior to applying joint coating.

3.05 PIPE LINING APPLICATION

A. Shop-applied Cement Mortar Lining:

1. Centrifugally line straight sections of pipe. Lining of special pieces or fittings shall be by mechanical, pneumatic, or hand placement. Provide cement mortar lining of uniform thickness. Finish to a smooth dense surface.
2. Steel plate fittings and specials larger than 16 inches in diameter shall have lining reinforced with 2-inch-by-4-inch No. 13 gage welded steel wire mesh.
3. Brace and support pipe during lining application to minimize pipe distortion or vibration. Bracing and supports shall not damage the pipe, coating, or lining.
4. Tightly close ends of pipe and fittings with plastic sheet caps. Plastic end caps shall be of sufficient thickness and strength to resist shipping, handling, and storage stresses.
5. Damage to the cement mortar lining, including spalling, loose, cracking, or blistering, caused by improper curing, shipping, handling, or installation shall be repaired in accordance with AWWA specifications and to the satisfaction of the Engineer.
6. Other requirements of mortar lining materials and processes: As specified in AWWA C205.

B. Liquid Epoxy Lining:

1. Clean and coat the interior of cement mortar lined pipe at insulating joints or where specified with two coats of epoxy coating.
2. Epoxy coating applied at insulating joints shall be applied to both sides of the insulating joint for a minimum of one pipe diameter. If only one side of the joint can be coated the coating shall be applied for a minimum of two pipe diameters.
3. Mortar lining shall be allowed to cure 15 days or steam cured not less than 7 days prior to surface preparation of the mortar and epoxy coating application. Hand applied mortar lining shall be allowed to cure a minimum of 15 days or as required to meet the coating manufacturer's requirements for application on cement or concrete, whichever is greater.
4. Prepared mortar lining by abrasive blasting to remove all laitance and create a suitable anchor profile.
5. Epoxy coating shall be applied in two coats minimum, at a total coating thickness of 16 mils dry film thickness. Coating applied over cement mortar lining shall be applied in a manner that will minimize gassing and pinholes in the completed lining.
6. Mortar lining shall be dry during epoxy lining application.

3.06 FIELD COATING JOINTS

A. General:

1. All joints without a holdback primer shall be prepared as follows:
 - a. Remove all oil and grease contamination from pipe and adjacent coating in accordance with SSPC-SP1, Solvent cleaning.
 - b. Clean pipe surface and adjacent coating of all corrosion and other foreign contaminants in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal or abrasive blast joints in accordance with SSPC-SP10, near white metal blast. Clean the full circumference of the pipe and a minimum of 4 inches onto the existing coating. No profile is required with SP-11 preparation.
2. All joints with a holdback primer shall be prepared by removing all oil and grease in accordance with SSPC-SP1, Solvent Cleaning, followed by spot preparation of visible corrosion or rust in accordance with SSPC-SP11, Power Tool Cleaning to Bare Metal.
3. Remove all loose or damage pipe coating at joint and either repair the coating as specified herein or increase the length of the joint coating, where reasonable and practical.
4. Joint bonds shall be installed before application of joint coating as specified in Section 26 42 10 Galvanic Cathodic Protection. Joint bonds shall be low profile bonds and all gaps and crevices around the bonds shall be filled with filler mastic.
5. Contractor to electrically test completed joint coating for holidays with high voltage spark tester at Engineer's direction or if damage to the joint coating occurs.

B. Weld After Backfill Joint Requirements:

1. Post-welded or 'Weld after Backfill' joints are defined as welded pipe joints that have been coated and backfilled prior to completing interior welds.
2. Post welded joints shall be coated and protected as follows:

- a. Joint coating shall be Canusa Aqua Shield AQW-HS or Raychem (Polyken) Covalence WaterWrap –WAB heat shrink joint sleeves only. Tape wrapped joints will not be acceptable.
 - b. Provide a 6-inch wide Canusa Aqua Shield AQW-WAB (or Raychem Equivalent) protective layer centered over the interior weld location as recommended by the joint sleeve manufacturer. Heat resistant tape will not be acceptable.
 - c. Hold back primer shall be suitable for post weld conditions as specified in this Section and shall not exhibit any binder breakdown in the heat affected zone that causes loss of joint coating adhesion to the holdback primer.
 - d. Filler mastic materials shall be high temperature materials with 500°F melting point.
 - e. Joints shall be buried prior to welding, with not less than 12-inch cover of soil or flowable fill material above the pipe, and minimum side and bottom of trench distances as shown in the project trench details.
3. Welding of the joints shall be in conformance with the Section 02570 – WELDED STEEL PIPE AND FITTINGS, and as indicated herein:
 - a. All welding shall be wire-fed or with stick electrodes, and two or more weld passes as required to meet the approved AWS qualified welding procedures and maximum coating temperature limitations. Not more than 1/8" shall be deposited per weld pass. 'Weld after Backfill' procedures must be approved by the Engineer based on field testing demonstrating the welding procedures can comply with the requirements of this Section.
 - b. Welding speed, amperage, and voltage shall be as required to maintain a maximum heat input of 23,000 joules or a maximum surface temperature at the coating/steel interface of 800°F, whichever is least.
 - c. Maximum weld temperature and duration shall not result in significant carbonization of the joint coating adhesive. Significant carbonization is defined as the loss of volatile organic compounds that result in substantial loss of tackiness, adhesion to the steel, and corrosion protection properties.
 - d. Finished joint coating shall not have any visual creases or folds that extend through more than 50% of the joint coating backing material.
 4. If Contractor elects to weld after backfill any joints, Contractor shall demonstrate that the joint welding procedures will not significantly damage the coating by using a temporary prototype test joint of the minimum wall thickness used on the project. The test joint shall be backfilled, and each welder proposed for the project shall be tested. Each welder shall provide a complete weld a minimum of two feet of weld overhead and below head. The test joint will be excavated after welding and destructively tested. The heat shrink sleeve shall be tested by an adhesion test in accordance with ASTM D1000, and shall meet an adhesion value of 15 lb-inch. Test shall be performed directly over the weld (parallel) and perpendicular to the weld. The sleeve backing shall not rip, tear, or split. The test shall be done a minimum of 24 hours after welding. Additionally, a visual inspection of the sleeve will be made to verify the sleeve is not damaged beyond the limits of this specification. Additionally, excavate the first two joints for evaluation of the joint coating condition. Engineer will randomly select up to three additional post-welded joints for excavation by Contractor for evaluation of joint coating condition. Joint coating will be destructively evaluated by the

Engineer. Contractor will removed and replace joint heat shrink sleeve upon completion of the evaluation.

5. In the event that any excavated post welded joint exhibits any heat related damage as defined herein, Contractor shall modify and test a new welding after backfill procedure prior to completing any additional welded joints. Contractor shall demonstrate that the revised joint welding procedure will not significantly damage the coating by repeating the weld after backfill evaluation requirements defined in this Section, including excavation of the three additional randomly selected joints for destructive evaluation.

C. Heat Shrink Sleeve Joint Coating:

1. Store, handle, and apply field heat shrink sleeve coatings in accordance with AWWA C216 and the Specifications.
2. Store sleeves in shipping box until use is required. Keep dry and sheltered from exposure to direct sunlight. Store off the ground or concrete floors and maintain at a temperature between 60°F and 100°F as recommended by the sleeve manufacturer.
3. Metal surface shall be free of all dirt, dust, and surface corrosion prior to sleeve application. Surface preparation shall be in accordance with the joint coating manufacturer's recommendations.
4. Where corrosion in the holdback area is visible, surfaces shall be prepared in accordance with SSPC-SP10, near white metal blast, or SSPC-SP11, power tool cleaning to bare metal.
5. Preheat pipe uniformly as recommended by the sleeve manufacturer. Monitor pipe temperature using a surface temperature gauge, infrared thermometer, or color changing crayons. Protect preheated pipe from rain, snow, frost, or moisture with tenting or shields and do not permit the joint to cool.
6. Fill all cracks, crevices, gaps, and step-downs greater than 1/8 inch with filler mastic in accordance with the manufacturer's recommendations for the full circumference of the pipe.
7. Apply heat shrink sleeve when it is at a minimum temperature of 40°F and while maintaining the pipe temperature above the preheat temperature specified. Apply sleeve in accordance with the manufacturer's instructions and center the sleeve over the joint to provide a minimum 2 inch overlap onto the existing pipe coating.
8. Completed joint sleeve shall be fully bonded to the pipe and existing coating surface without voids. Mastic beading shall be visible along the full circumference of the sleeve. There shall be no wrinkling or excessive burns on the sleeves. Sleeves that do not meet these requirements shall be removed and the joint recoated as directed by the Engineer. Minor repairs may be repaired using heat applied patch material specified for minor coating repairs.
9. Allow the sleeve to cool before backfilling. In hot climates, provide shading from direct sunlight. Water quenching will be allowed only when permitted by the sleeve manufacturer.
10. Heat shrink joint coatings which have become wrinkled or disbonded because of prolonged exposure to UV light or thermal cycling shall be removed and replaced.

11. Double coating of defective or damaged heat shrink coatings will not be permitted. Any double coated heat shrink sleeves shall be immediately rejected and Contractor shall remove the existing coating and recoat the joint.

D. Cement Mortar Coating:

1. Cement mortar coating shall be applied to the joints of cement mortar over coated steel pipe in accordance with AWWA C205.
2. Field repair cement mortar coating in accordance with AWWA C205.
3. Joint Diapers:
 - a. Polyethylene Foam:
 - 1). Cut into strips wide enough to match uncoated field joint area.
 - 2). Slit to thickness of 1/4 inch that will expose a hollow or open cell surface on one side.
 - 3). Foam liner shall be attached to fabric backing with open or hollow cells facing towards pipe.
 - 4). Foam strip shall cover full interior circumference of grout band with sufficient length to permit 8 inch overlap of foam at or near top of joint.
 - 5). Splices to provide continuity of material will be permitted.
 - 6). Protect polyethylene foam material from direct sunlight.

3.07 REPAIR OF COATING AND LININGS

A. General:

1. All areas where holidays are detected or coating is visually damaged, such as blisters, tears, rips, bubbles, wrinkles, cuts, or other defects shall be repaired. Areas where no holidays are detected, but are visually damaged shall also be repaired.
2. Maximum defects allowable shall be as specified herein for the coating system.

B. Tape Wrap Coating Repairs:

1. General:
 - a. No more than five repairs per joint of pipe will be permitted with tape wrap coating, excluding adhesion test damage. The coating on any pipe with more than five coating repairs or with more than two areas of coating damage greater than five square feet will be rejected.
 - b. Pipes exceeding the maximum number or size of coating defects shall be stripped, reblasted, and recoated.
 - c. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the CONTRACTOR's expense.
 - d. The number of layers and total thickness of the tape repair coating shall be the same as the shop-applied coating; unless heat applied coating materials is used.
 - e. Wipe the area to be repaired with solvent for a minimum distance of 4 inches outside the damaged area.
2. Defect Size:

- a. Minor repairs – Any repair that are less than 6 inches in the greatest dimension, measured after cutout of damaged tape layers. Damage to the corrosion protection tape layer will be considered minor if repairs are made using heat applied patch materials.
 - b. Major repairs - repairs that exceed 6-inches in the greatest dimension or where damage to the inner tape layer has occurred and hand applied tape repairs will be used.
- 3. Minor Repairs:
 - a. Complete minor repairs using a heat applied coating patch material.
 - b. Cut patch material to overlap onto the undamaged coating a minimum of 2 inches on all sides with 1-inch radius on each corner of the patch.
 - c. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.
 - d. Cut middle and outer layers in stepped fashion to expose 1-inch or more of the underlying tape layer for the circumference of the repair.
- 4. Major Repairs (Over 24-inches Diameter):
 - a. Cigarette wrap coating repairs shall be with heat shrink sleeves as specified for joints.
 - b. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap.
 - c. Holiday test the inner wrap and if a holiday is detected cut outer layers back to fully exposed the holiday(s) and retest for holidays.
 - d. Cut middle and outer layers in stepped fashion to expose 1-inch or more of the underlying tape layer for the circumference of the repair.
 - e. Width of sleeve shall be the width of the damaged area plus 4-inch overlap. Multiple sleeves may be used for larger repairs, but must be overlapped a minimum of 2 inches.
- 5. Major Repairs (24-inch Diameter or Less)
 - a. Cigarette wrap repairs on pipe less than 24-inches with heat shrink sleeves as specified for major repairs.
 - b. Carefully remove damaged layers by cutting the coating with a sharp knife without cutting or damaging the inner wrap. Holiday test the inner wrap and if a holiday is detected apply one extra layer of repair tape.
 - c. Clean surfaces by solvent wiping and applying primer over the inner tape layer for a minimum of 6-inches onto the outer wrap in all directions.
- C. Polyurethane Coating or Lining Repairs:
 - 1. General:
 - a. Complete coating or lining repairs in accordance with the coating manufacturers written instructions and the Specifications, whichever is stricter.
 - b. Defect Size:
 - 1). Minor Repairs: Repairs that are less than 6 inches in the greatest dimension.
 - 2). Major Repairs: Repairs that exceed 6 inches in the greatest dimension.

- c. Pipes exceeding the maximum number or size of coating defects shall be stripped of coating, reblasted, and recoated.
- 2. Maximum Quantity of Defects Allowed:
 - a. Minor coating or lining repairs on any joint of pipe shall not exceed 1.5 per 100 square feet of surface area.
 - 1). Two or more minor repairs within a 6 inches diameter circle will be considered a single repair.
 - 2). Repairs for adhesion testing will not be included in the total number of repairs.
 - b. Major repairs shall not exceed two per pipe joint and the combined area shall not be greater than 20 percent of the pipe.
 - c. Pipes exceeding the maximum number or size of coating defects shall be stripped of coating, reblasted, and recoated.
 - d. Pipe arriving in the field with defects or repairs exceeding the maximum number or size of coating defects will be returned to the shop for recoating at the Contractor's expense.
- 3. Minor Repairs:
 - a. Surface Preparation: Clean and feather the defect by power tool sanding with 80 grit or coarser sandpaper to roughen the existing coat and feather the edges of the defect for a minimum of 2 inches around the defect.
 - b. Shop repair Materials:
 - 1). Slow setting parent material polyurethane coating material in syringes or other single use packaging that controls mix ratio.
 - 2). Coating manufacturer's polyurethane coating repair products subject to Engineer approval.
 - c. Field Repair Materials:
 - 1). Melt stick coating repair (not acceptable for repairs greater than 1-inch diameter); ScotchCoat P206, Canusa Melt Stick, or approved equal.
 - 2). Protal 7125 Fast Cure Epoxy.
 - 3). Heat applied coating materials; CRP Patch, Canusa; PERP Patch, Tyco Adhesives, or approved equal.
 - 4). Coating manufacturer's polyurethane coating repair products subject to Engineer approval.
 - d. Apply a single coat of the specified patch coating material at the specified coating thickness.
 - e. Polyurethane or epoxy repair adhesion shall be 50 percent of the specified coating adhesion.
- 4. Major Repairs:
 - a. Major repairs shall not exceed two per pipe joint and the combined area shall not be greater than 20 percent of the pipe.
 - b. Major repairs:
 - 1). Surface Preparation:

- a). The metal surface and surrounding coating shall be abrasively blasted in accordance with SSPC-SP10, near white metal, or to equal in cleanliness and profile as the original surface preparation.
 - b). Existing coating shall be feathered and roughened to the equivalent of 40 grit sandpaper.
- 2). Shop Repair Materials:
 - a). Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.
- 3). Field Repair Materials:
 - a). Same material as the pipeline coating or lining and shall be applied by using plural component spray equipment.
 - b). Heat shrink sleeves as specified for pipeline joints.
 - c). One coat of the specified original coating material shall be applied over the repaired surface at the specified thickness.
 - d). Repair adhesion shall be equal to the specified coating adhesion.
- D. Cement Mortar Coating and Lining:
 - 1. Cement mortar that is cracked or disbonded shall be repaired in accordance with AWWA C205, except for mortar overcoat on dielectric coated steel.
 - 2. Disbonded cement mortar shall be removed and patched.
 - 3. Cement mortar with disbondment greater than 25 percent of the pipe surface shall be rejected and recoated.
 - 4. Cracks in cement mortar shall be repaired in accordance with AWWA C205.

3.08 QUALITY CONTROL TESTING AND INSPECTION

A. General:

- 1. Applicator shall inspect and test the coating system in accordance with referenced standards and the Specifications, whichever is more stringent.
- 2. The frequency of the testing shall be determined by the applicator, but shall not be less than the requirements of this Section.
- 3. Owner or Owner's representative will conduct random independent inspections and tests for the final acceptance or rejection of pipe coating or lining.
- 4. Contractor to perform holiday testing in the field using equipment provided as specified in Paragraph 2.02. Tests will be completed in the presence of the Owner's representative on each joint of pipe and fitting once the pipe has been lifted to be lowered into the trench. Holidays shall be repaired as specified.

B. Soluble Salt Contamination (SSC) Testing

- 1. Residual soluble salt contamination (SSC) shall be verified using an Elcometer Model E130-TC Salt Contamination Meter, or equal, before and after surface preparation.
- 2. Testing after blasting is not required if the preblast test passes the maximum soluble salt contamination criteria.
- 3. Maximum soluble salt contamination levels shall be:
 - a. 2.0 µg/cm² – Immersion or buried
 - b. 5.0 µg/cm² – non-immersion

C. Surface Profile Testing

1. Surface profile of abrasive blasted surfaces to be tested with "Press-O-Film" tester tape or equivalent in accordance with NACE RP287.
2. Tester tape shall be suitable for the intended profile height.
3. Profile shall be measured to a minimum tolerance of 0.1 mils, maximum.
4. Electronic surface profilometers shall be used, as deemed necessary, to verify tester tape measurements.

D. Adhesion Testing:

1. General:

- a. Adhesion testing shall be conducted at the shop prior to shipment. Pipe shipped without adhesion testing will be field-tested. Pipe rejected in the field will be returned to the shop for repair at the sole expense of the Contractor.
- b. A minimum of two pipes shall be tested for adhesion from each lot of pipe coated up to 2500 square feet of pipe. An additional adhesion test shall be conducted on every increment up to 1500 square feet of pipe coated in excess of the first 2500 square feet of pipe. (i.e. if one workday of production is 3000 square feet of pipe, three adhesion tests would be conducted on the pipe lot.) Adhesion testing shall be conducted on not less than 25 percent of each pipe produced within a lot.
- c. A pipe lot is defined as the quantity of pipe that is coated by a single crew within a work shift, but not to exceed 10 hours.
- d. The pipe coating applicator shall repair all coating damage from shop adhesion testing performed by applicator and Owner's Representative. Contractor shall be responsible for coating repairs for all field adhesion testing.
- e. Adhesion tests shall be performed not less than 24 hours after coating application. Tests conducted prior to 24 hours will be acceptable only if the test meets or exceeds the adhesion criteria specified and the test was requested by the pipe fabricator.
- f. Pipe shall be randomly selected for adhesion testing. The Owner reserves the right to perform adhesion testing at any time or location.

2. Rejection of Coating:

- a. If any pipe within a lot fails to meet the test criteria specified for the coating type, that pipe shall be rejected along with all other pipes within the lot. Each pipe within the rejected pipe lot will then be individually tested and rejected on a pipe-by-pipe basis in conformance with the test procedures and criteria specific for the coating type.
- b. If more than 25% of the pipes within a lot fail, then the entire lot shall be rejected.
- c. All rejected pipe shall have all coating removed from the full length pipe and the pipe abrasive blasted and recoated.

3. Tape Coating Adhesion Testing:

- a. Inner tape coating shall have an adhesion to steel of 20 pounds per inch width or 15 pounds per inch width for ductile iron, minimum, when tape is pulled in a continuous manner at an angle of 180 degrees to the pipe surface.

- b. Tape adhesion testing shall be conducted prior to application of the cement mortar overcoat. Pipe that has been mortar coated prior to adhesion testing shall have the mortar coating removed by the CONTRACTOR as directed by the Engineer and of sufficient dimensional area to permit the adhesion test to be conducted.
 - c. Adhesion tests shall be conducted at temperatures above 60 degrees and less than 75 degrees.
 - d. Pulling tension shall be continuous, without stopping, and monitored throughout the length of the pull, which shall be not less than 12-inches in length.
 - e. Adhesion test shall be prepared by making two parallel cuts through the coating, 1-inch apart, of sufficient length for the test pull. Peel the coating back at one end and attach the tension scale to the coating with a suitable clamp. Mark the coating at one inch increments from 0 to 12-inches.
 - f. The pull tension shall be recorded for each inch of pull. The two highest and two lowest readings shall be discarded and the remaining values averaged. Pull speed shall be not less than 5 seconds per inch or greater than 10 seconds per inch. If elongation of the tape backing occurs, pull speeds may exceed 10 seconds per inch provided the minimum adhesion rating can still be achieved.
 - g. Failure shall be by cohesive failure of the adhesive only. Delamination failure, defined as separation of the adhesive from the backing material, will result in rejection of the tape lot. Intermittent skip failures will be counted as zero pounds of adhesion and included in the calculations for average coating adhesion. Adhesive failure, defined as separation of the adhesive from the metal substrate, will be rejected.
 - h. Pipe that fails the test by delamination will be retested on two other pipes within the same lot of coated pipe. Failure of any two pipes within the lot will result in rejection of all pipes coated with the rejected tape lot.
4. Polyurethane Adhesion Testing:
- a. Polyurethane coatings or linings shall have an adhesion to steel of 2,000 pounds per square inch, minimum. **One pull test will be required.** If the test shows adhesive or cohesive failure values less than 2,000 psi, then two additional tests shall be taken within 4 inches of the failing pull test. If the average of the three tests is less than 2,000 psi, or any test is below 1500 psi, then the adhesion test shall be deemed a failed test and the pipe will be rejected. If the average is above 2,000 psi and no single pull is below 1500 psi, then the test will be deemed a passing test. If a test fails, then all pipe segments within the lot shall be tested using three adhesion pulls per pipe segment within 4 inches of each other. If the average of three tests is less than 2,000 psi, or a single pull is less than 1500 psi, then the pipe segment will be rejected. If more than 25% of the segments within a lot fail, then the entire lot shall be rejected.
 - b. Polyurethane coating adhesion to steel substrates shall be tested using pneumatic pull off equipment, such as Defelsko Positest, in accordance with ASTM D4541 and AWWA C222, **except as modified in this section.** All adhesion tests shall be performed at an applied load rate of 100 psi per second, plus or minus 10 psi. Automatic pull rate adhesion test equipment shall be used.

- (a) Adhesion tests shall utilize 20 mm diameter dollies.
 - (b) When three tests are required on a single pipe, all three tests shall be conducted by the same person, test equipment, and test procedure.
 - (c) All dollies shall be scored to metal substrate using manual methods and tools, normal to the pipe surface, and in a manner that does not stress or over heat the coating.
 - (d) Adhesion testing shall be performed at temperatures between 55 and 100 degrees F. Tests may be performed at temperatures up to 115 degrees F or as low as 45 degrees if testing can demonstrate no statistically detectable affect in the test results and subject to Engineer approval.
- c. Adhesion testing records shall include pipe identification, surface tested (interior or exterior), surface temperature, coating thickness, tensile force applied, mode of failure, and percentage of substrate failure relative of dolly surface. Records of all adhesion tests shall be maintained in an electronic spreadsheet that includes pipe identification, pipe coating date, adhesion test date, surface tested (interior or exterior), surface temperature at time of test, coating thickness, tensile force applied, applied load rate per second, mode of failure, and percentages of failure types present relative to dolly surface area
 - d. Polyurethane coatings shall be scored around the dolly prior to conducting the adhesion test.
 - e. Failure shall be by adhesive and cohesive failure only. Adhesive failure is defined as separation of the coating from the steel substrate. Cohesive failure is defined as failure within the coating, resulting in coating remaining both on the steel substrate and dolly.
 - f. Partial substrate and glue failures will be retested if the substrate failure is less than 50 percent relative of the dolly surface area and the applied tension was less than the specified adhesion. Pipes that have partial substrate failures greater than 50 percent and less than the specified adhesion will be rejected as a substrate adhesion failure.
 - g. Glue failures in excess of the minimum required tensile adhesion would be accepted as meeting the specified adhesion requirements.
 - h. Adhesion tests will be conducted on polyurethane pipe coating and lining independently and will be accepted or rejected independently of the other.
 - i. Repair patches on the polyurethane coating shall be randomly selected for adhesion testing in a manner as described herein and at the discretion of the coating inspector conducting the adhesion tests. Adhesion of repairs shall be as specified for the type of repair
5. Repair patches on the polyurethane coating shall be randomly selected for adhesion testing in a manner as described herein and at the discretion of the coating inspector conducting the adhesion tests. Adhesion of repairs shall be as specified for the type of repair. A minimum of two adhesion tests per week shall be provided for repair patches.

E. Holiday Testing:

- 1. Holiday test the inner layer of tape wrap coatings after application and prior to the subsequent tape layer in accordance with AWWA C214 and NACE Standard RP-0274
- 2. Holiday tests on polyurethane coatings or linings will be conducted on the completed coating or lining after cure or 24-hours, whichever is less, using a high

voltage spark test in accordance with NACE Standard RP 0274 and the Specifications. In addition, the pipe shall be holiday tested after storage and delivery to the jobsite, approximately one day prior to installation in the trench.

3. Coating thickness used for holiday testing shall be the minimum specified coating thickness.

F. Dry Film Thickness Testing:

1. Coatings shall be tested for dry film thickness using a properly calibrated magnetic pull off or eddy current equipment.
2. Coating thickness measurements shall be conducted as necessary and without limitation. Testing conformance to the requirements of SSPC PA-2 is specifically excluded from this Section.

3.09 HANDLING, TRANSPORTATION, AND STORAGE

- A. Pipe shall be handled in such a manner as to protect the pipe and coating from damage.
- B. Coated pipe shall not be shipped or installed until coating has developed full adhesion and cure.
- C. During coating application, storage, loading, transportation, unloading, laying and installation, every precaution shall be taken to protect and prevent damage to pipe, lining, and coating. Forklift equipment shall have all bearing surfaces padded with suitable padding material. Lift pipe with web slings a minimum of 12-inch wide and of a type that will not damage the coating. Metal chains, cable, tongs, forklifts or other equipment likely to damage the coating will not be permitted. Dragging or skidding of pipe on grade or in the trench will not be permitted.
- D. Provide transportation vehicles with padded bolsters between each layer of pipe and heavy padding under load ties. Bolsters shall be curved to fit the outside of the pipe and 12 inches wide, minimum. All pipe contact locations shall be heavily padded with carpet and strips of the outer tape wrap material (adhesive side against the carpet) during shipment to the Site and from the storage yard to the point of installation.
- E. Pipe shall not be stored on rocks, gravel, or other hard materials that might damage the coating. Provide padded 12-inch wide skids and chucks, sand bags, select loamy or sand berms, or suspended from cutback ends, where possible, to minimize coating damage. Pipe shall not be laid on asphalt without suitable padding at all contact points.
- F. Pipe shall be inspected by the Contractor at the Site for damage. Any damage to the pipe, lining, or coating shall be repaired as directed if, in the opinion of the Engineer, a satisfactory repair can be made; otherwise, the damaged section shall be replaced at the sole expense to the Contractor.
- G. No metal tools or heavy objects shall be permitted to come into contact unnecessarily with the finished coating. Workmen shall not be permitted to walk on the coating except when absolutely necessary and approved by the Engineer. When permitted, shoes with rubber or composition soles and heels or other suitable footwear that will not damage coating shall be used.
- H. Long-term Exposure: Pipe shall either be provided with UV inhibitor for storage longer than one year or above grade exposure or covered to prevent UV degradation of outer wrap. Amount of UV stabilizers required will depend on the Project location, laying schedule, anticipated length of exposure, and type of outer wrap.

Manufacturer shall be consulted for recommended UV inhibitors requirements or pipe shall be stored under a protective cover. Protective covering can be colored plastic sheeting, canvas, or other UV blocking material. Clear plastic sheets are not acceptable. Areas of coating that display UV degradation shall be removed and repaired at sole cost of the Contractor.

- I. End Caps: Pipe ends of mortar lined pipe and fittings shall be tightly closed with a plastic wrap to aid in curing and to minimize drying out of and contamination of the lining. Plastic end cap shall consist of a minimum of one 10-mil sheet of polyethylene or other suitable material. End caps shall be substantial enough to resist shipment, handling, and storage loads and firmly attached in place. The plastic end cap shall remain intact and in place until pipe installation. Damaged or missing plastic end caps shall be repaired or replaced.

END OF SECTION

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SECTION 09 96 00
HIGH PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Surface preparation and field painting/protective coatings of process piping, process pipe support systems, and associated process system appurtenances.
2. Surface preparation and field coating of submerged metals.

B. Related Sections include, but are not limited to:

1. Section 01 11 00 – Summary of Work
2. Section 01 33 00 – Submittal Procedures
3. Section 01 45 00 – Quality Control
4. Section 01 61 00 – Common Product Requirements
5. Section 01 65 00 – Product Delivery Requirements
6. Section 01 66 00 – Product Storage and Handling Requirements
7. Section 01 75 00 – Starting and Adjusting
8. Section 01 77 00 – Closeout Procedures
9. Section 01 78 23 – Operations and Maintenance Data
10. Section 01 79 00 – Demonstration and Training
11. Division 40 – Process Integration
12. Division 43 – Process and Liquid Handling and Storage
13. Division 46 – Process Equipment and Water and Wastewater Equipment

1.02 REFERENCES

A. Reference standards include, but are not limited to:

1. American National Standards Institute (ANSI).
2. American Society for Testing Materials (ASTM).
3. American Water Works Association (AWWA).
4. ASTM D16 – Standard Terminology for Paint, Related Coatings, Materials and Applications.
5. ASTM D3359 – Standard Test Methods For Rating Adhesion by Tape Test.
6. ASTM D4263 - Indicating Moisture in Concrete by the Plastic Sheet Method.
7. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
8. AWWA D102-06 – Coating Steel Water-Storage Tanks.

9. National Association of Corrosion Engineers International (NACE) – Industrial Maintenance Painting.
10. Occupational Safety and Health Administration (OSHA).
11. Recommended Standards for Water Works (Ten State Standards), 2012 Edition, Section 2.14 – Piping Color Code.
12. Standards for the Society for Protective Coatings (SSPC) – Steel Structures Painting Manual.
13. Surface Preparation Standards (SW), Sherwin-Williams Company.
14. Uniform Building Code (UBC).
15. Uniform Fire Code (UFC).

1.03 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this Section.
- B. Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000 inch).

1.04 QUALITY ASSURANCE

- A. Product Manufacturer:
 1. Specialize in manufacture of coatings with a minimum of five (5) years successful experience.
 2. Able to demonstrate successful performance on comparable projects.
 3. Single source responsibility: coatings and coating application accessories shall be Products of a single manufacturer.
- B. Applicator:
 1. Company specializing in commercial painting and finishing with five (5) years documented experience.
 2. Applicator's personnel: employ persons trained for application of specified coatings.
 3. Must have a letter from product manufacturer certifying they are an approved applicator.
- C. Contractor Provide:
 1. Manufacturer's certification that proposed coating system meets specified performance requirements.
 2. SSPC visual standards onsite.
 3. Paint thickness measurement instrument onsite.
- D. Pre-Application Meeting:

1. Convene a pre-application meeting two (2) weeks before the start of application of coating systems.
2. Require attendance of parties directly affecting work of this section, including the Contractor, Engineer, applicator, and manufacturer's representative.
3. Review environmental requirements, protection of surfaces not scheduled to be coated, materials, surface preparation, application, curing, disinfection, repair, field quality control, cleaning, protection of coating systems, one-year inspection, and coordination of other work.

1.05 SUBMITTALS

- A. Comply with Section 01 30 00 – Submittal Procedures.
- B. Product Data: submit manufacturer's Product data for each coating including generic description, complete technical data, surface preparation, and application instructions.
- C. Submit samples under provisions of Section 01 30 00 – Submittal Procedures.
- D. Operations and Maintenance Data shall be submitted in accordance with specification Section 01 78 23 – Operation and Maintenance Data.
- E. Color Samples: submit two (2) sample sheets illustrating available colors for each scheduled surface finish Product.
- F. Potable Water Certification: submit certification that liner material has been classified by an ANSI certified laboratory to ANSI/NSF 61 in tanks, pipes, and joints.
- G. Manufacturer's Quality Assurance: submit manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.
- H. Applicator's Quality Assurance:
 1. Submit list of minimum of five (5) completed projects of similar size and complexity to this Work. Include for each project:
 - a. Project name and location.
 - b. Name of owner.
 - c. Name of Contractor.
 - d. Name of engineer.
 - e. Name of coating manufacturer.
 - f. Approximate area of coatings applied.
 - g. Date of completion.
 - h. Name and number of contact person at project site.

2. Submit product manufacturer's letter certifying approval of applicator for specified products.
- I. Maintenance Manual: submit maintenance manual containing instructions for the Owner on how to properly maintain coatings.
- J. Warranty: submit to Owner manufacturer's standard warranty.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 65 00 and Section 01 66 00.
- B. Delivery:
 1. Deliver materials to site in manufacturer's original, unopened containers and packaging with labels clearly indicating:
 - a. Coating or material name.
 - b. Manufacturer.
 - c. Color name and number.
 - d. Batch or lot number.
 - e. Date of manufacture.
 - f. Mixing or thinning instruction.
 - g. Coverage.
 - h. Surface preparation.
 - i. Drying time.
 - j. Cleanup.
 2. Inspect to verify acceptance.
 3. Do not deliver materials to site more than two (2) weeks before use.
- C. Storage:
 1. Store materials in accordance with manufacturer's instructions.
 2. Store materials indoors in an area well ventilated and protected from damage.
 3. Do not store materials near open flame, sparks, or hot surfaces.
 4. Store materials on raised platforms and protected by waterproof covers.
 5. Keep material containers sealed until ready for use.
 6. Keep a copy of the applicable material safety data sheets with each material.
 7. Do not use materials beyond manufacturer's shelf life limits.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Weather:
 1. Air and Surface Temperatures: prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer's instructions.

2. Surface Temperature:
 - a. Minimum of 5°F above dew point and rising.
 - b. Do not apply to porous substrates when substrate or ambient temperatures are rising.
 - c. Do not apply to porous substrates when substrate is in direct sunlight.
 - d. Do not apply over substrates that are frozen or contain frost.
 - e. Provide lighting level of 80 foot candles measured mid-height at substrate surface.
 - f. Consult manufacturer for cold weather application instructions.
3. Relative Humidity: prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer's instructions.
4. Precipitation:
 - a. Do not prepare surfaces or apply coatings in rain, snow, fog, mist, or when moisture is imminent.
 - b. Do not apply when the surface may become wet within four (4) hours after application.
5. Wind:
 - a. Do not spray coatings if wind velocity is above manufacturer's limit.
 - b. Protect all surrounding surfaces from overspray or wind carried coating materials.

B. Ventilation:

1. Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D102 and these specifications.
2. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45°F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

C. Dust and Contaminants:

1. Schedule coating work to avoid excessive dust and airborne contaminants.
2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.
3. Refer to Paragraph 3.03 of this specification for additional requirements.

1.08 REGULATORY REQUIREMENTS

A. Conform to applicable codes and standards:

1. Environmental Protection Agency
2. Ten State Standards

3. Uniform Building Code
 4. Uniform Fire Code
- B. All Products that may come into contact with water intended for use in a Public Water System shall meet ANSI/NSF International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

1.09 WARRANTY

- A. Provide a five (5) year materials and one (1) year labor warranty. Obtain material warranty from manufacturer. Warranty period shall begin at the date of Substantial Completion as indicated in Section 00 72 00 – General Conditions.
- B. One (1) Year Inspection:
1. Engineer will set date for one (1) year inspection of coating systems.
 2. Inspection shall be attended by Owner, Contractor, Engineer, and manufacturer's representative.
 3. Repair deficiencies in coating systems as determined by Engineer in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 APPROVED MANUFACTURERS

- A. All materials selected for coating systems for each type of surface shall be the Product of one (1) manufacturer.
1. Sherwin-Williams Company.
 2. Tnemec Company, Inc.
 3. PPG Industrial Coating.
 4. Prior Approved Equivalent.

2.02 MATERIALS

- A. Material compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Coatings: ready mixed, except field-catalyzed coatings. Process pigments to soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating.

- C. Coatings: good flow and brushing properties; capable of drying or curing free of streaks or sags.
- D. Accessory Materials: linseed oil, shellac, turpentine, paint thinners, and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.
- E. Materials shall contain no lead.

2.03 FINISHES

- A. Refer to schedule at end of Section for surface finish.
- B. Colors shall match existing colors at the facility, be selected by the Engineer and Owner, or be designated as recommended by Ten States Standards 2003 Edition. Refer to section 40 46 16.
- C. Where more than one (1) coat is required, there shall be contrasting colors for each.

2.04 ACCESSORIES

- A. Coating Application Accessories:
 - 1. Accessories required for application of specified coatings in accordance with manufacturer's instructions, including thinners.
 - 2. Products of coating manufacturer.

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor shall provide, erect, and maintain all required hoists, scaffolding, staging and planking, and perform all access related hoisting work required to complete the Work of this Section as specified.

3.02 EXAMINATION

- A. Inspect substrate and adjacent areas where coating system will be applied. Notify Engineer of conditions that would adversely affect the application or subsequent utilization of the coating. Do not proceed with application until unsatisfactory conditions are corrected by Contractor.
- B. Contractor shall examine the areas and conditions under which the protective coating Work is to be performed in accordance with NACE SP0892, Table 1 and SSPC-SP13/NACE No. 6, and notify Engineer in writing of conditions detrimental to the proper and timely completion of the Work.

- C. Contractor shall confirm the presence of a positive side waterproofing on the exterior of the concrete structures constructed to hold water.
- D. Commencement of the Work of this Section shall indicate that the substrate and other conditions of installation are acceptable to the Contractor and his Applicator, and will produce a finished product meeting the requirements of the Specifications. All defects resulting from accepted conditions shall be corrected by Contractor at his own expense.
- E. Test shop applied primer and finishes for compatibility with subsequent cover materials.
- F. Stopping Active Leaks: After surface cleaning, any visible leaks or other water ingress shall be reported to the Engineer. Any water infiltration through minor leaks that does not stop within 30 days must be stopped using a polyurethane grout manufactured by Avanti International, Xypex Corporation, or approved equal, or other approved method in accordance with ACI 221.1R. Surface and grouting material may require additional surface preparation prior to application of protective coating.

3.03 PREPARATION

- A. General:
 - 1. Prepare surfaces per Drawings, Specifications, and manufacturer's recommendations.
 - 2. Remove and protect electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
 - 3. Correct minor defects and clean surfaces which affect Work of this Section.
 - 4. Seal marks which may bleed through surface finishes.
 - 5. Impervious Surfaces: remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to thoroughly dry.
 - 6. Concrete and Concrete Unit Masonry Surfaces Scheduled to Receive Paint or Concrete Waterproofing Membrane Finish: remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Ensure concrete and concrete masonry surfaces are fully cured and dry.
 - 7. Shop Primed Steel and Iron Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Prime shop primed items, as indicated.

8. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs. See schedule for preparation requirements.

B. Surface Preparation:

1. Aluminum (SW-1):
 - a. Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP1, Solvent Cleaning.
2. Block - Cinder and Concrete (SW-3):
 - a. Remove all loose mortar and foreign material from block. Surface must be free of laitance, concrete dust, dirt, form release agents, moisture curing membranes, loose cement, and hardeners.
 - b. Concrete and mortar must be cured at least 30 days at 75°F.
 - c. The pH of the surface should be between 6 and 9.
 - d. On tilt-up and poured-in-place concrete, commercial detergents and abrasive blasting may be necessary to prepare the surface.
 - e. Fill bug holes, air pockets, and other voids with a cement patching compound.
3. Concrete (SW-5):
 - a. Cure: concrete must be cured prior to coating application. Cured is defined as concrete poured and aged at a material temperature of at least 75°F for at least 30 days. The pH of the surface should be between 6 and 9.
 - b. Moisture (ASTM D4263): concrete must be free of moisture as much as possible (20% or less). Test for moisture or dampness by taping the four edges of an 18-inch by 18-inch plastic sheet (4 mils thick) on the bare surface, sealing all of the edges. After a minimum of 16 hours, inspect for moisture, discoloration, or condensation on the concrete or the underside of the plastic. If moisture is present, the source must be located and the cause corrected prior to painting.
 - c. Moisture (ASTM F1869): provide calcium chloride moisture testing kits as required to determine the pounds of water emitted from the slab in 1000 square feet over 24 hours. Provide one (1) test per 1000 square feet of floor space and at least a minimum of three (3) tests. Ensure the test surface area is clean 24 hours prior to testing and space is climate controlled for the duration of the testing.
 - d. Temperature: air, surface and material temperature, must be at least 50°F (10°C) during the application and until the coating is cured.
 - e. Contamination: remove all grease, dirt, loose paint, oil, tar, glaze, laitance, efflorescence, loose mortar, and cement by the recommendations Methods A, B, C, or D, listed below.

- f. Surface Condition: hollow areas, bug holes, honeycombs, voids, fins, form marks, protrusions, or rough edges are to be ground or stoned to provide a smooth, continuous surface of suitable texture for proper adhesion of the coating. Imperfections may require filling with a compatible material.
- g. Concrete Treatment: hardeners, sealers, form release agents, curing compounds, and other concrete treatments must be compatible with the coatings, or be removed.
- h. Methods of Surface Preparation for Concrete: select surface preparation method that best fits intended application and manufacturer's surface preparation recommendation(s).
 - 1) Method "A" - Blast Cleaning: includes dry blasting, water blasting, water blasting with abrasives, and vacuum blasting with abrasives.
 - 1) Use 16 - 30 mesh sand and oil-free air.
 - 2) Remove all surface contamination.
 - 3) Stand approximately 2-feet from the surface to be blasted.
 - 4) Move nozzle at a uniform rate.
 - 5) Laitance must be removed and bug holes opened.
 - 6) Surface must be clean and dry and exhibit a texture similar to that of medium grit sandpaper.
 - 7) Vacuum or blow down and remove dust and loose particles from the surface.
 - 2) Method "B" - Power Tool Cleaning or Hand Tool Cleaning:
 - 1) Use needle guns or power grinders, equipped with a suitable grinding stone of appropriate size and hardness, which will remove concrete, loose mortar, fins, projections, and surface contaminants. Hand tools may also be used.
 - 2) Vacuum or blow down to remove dust and loose particles from surface.
 - 3) Test for moisture or dampness by taping the four edges of an 18-inch by 18-inch plastic sheet (4 mils thick) on the bare surface, sealing all of the edges. After a minimum of 16 hours, inspect for moisture, discoloration, or condensation on the concrete or the underside of the plastic. If moisture is present, the source must be located and the cause corrected prior to painting.
 - 3) Method "C" - Surface Cleaning:
 - 1) The surface must be clean, free of contaminants, loose cement, mortar, oil, and grease. Broom cleaning, vacuum cleaning, air blast cleaning, water cleaning, and steam cleaning are suitable as outlined in ASTM D4258.
 - 2) Concrete curing compounds, form release agents, and concrete hardeners may not be compatible with recommended coatings. Check for compatibility by

- applying a test patch of the covering at least 2 to 3 square feet.
- 3) Allow concrete to dry one (1) week before testing adhesion per ASTM D3359. If the coating system is incompatible, surface preparation per methods outlined in ASTM D4259 are required.
4. Copper (SW-7):
 - a. Remove all oil, grease, dirt, oxide and other foreign material by cleaning per SSPC-SP 2, Hand Tool Cleaning. Preparation shall include solvent clean (SSPC-SP1 Solvent Cleaning) and light abrasion for an anchor profile.
 5. Galvanized Metal (SW-10):
 - a. Allow galvanized metal to weather a minimum of 6 months prior to coating.
 - b. Solvent clean per SSPC-SP1, then prime as required.
 - c. When weathering is not possible or the surface has been treated with chromates or silicates, first Solvent Clean per SSPC-SP1 and apply a test area, priming as required.
 - d. Allow the coating to dry at least one week before testing.
 - e. If adhesion is poor, Brush Blast per SSPC-SP16 is necessary to remove these treatments.
 6. Previously Coated Surfaces (SW-12):
 - a. All surface contamination such as oil, grease, loose paint, mill scale dirt, foreign matter, rust, mold, mildew, mortar, efflorescence, and sealers must be removed to assure sound bonding to the tightly adhering old paint.
 - b. Glossy surfaces of old paint films must be clean and dull before repainting. Thorough washing with an abrasive cleanser will clean and dull in one operation, or, wash thoroughly and dull by sanding.
 - c. Spot prime any bare areas with an appropriate primer.
 - d. Recognize that any surface preparation short of total removal of the old coating may compromise the service length of the system. Check for compatibility by applying a test patch of the recommended coating system, covering at least 2 to 3 square feet. Allow surface to dry one week before testing adhesion per ASTM D3359. If the coating system is incompatible, complete removal is required (per ASTM 4259, S-W 5, Method "A").
 7. Steel: Structural, Plate, etc. should be cleaned by one or more of the nine surface preparations described below:
 - a. Solvent Cleaning (SW-13, SSPC-SP1):
 - 1) Remove of all visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsifying agent, or steam.
 - 2) Change rags and cleaning solution frequently so that deposits of oil and grease are not spread over additional areas in the cleaning process. Provide adequate ventilation.

- b. Hand Tool Cleaning (SW-14, SSPC-SP2):
 - 1) Remove all loose mill scale, loose rust, and other detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing.
 - 2) Before hand tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP 1.
- c. Power Tool Cleaning (SW-15, SSPC-SP3):
 - 1) Remove all loose mill scale, loose rust, and other detrimental foreign matter by power tool chipping, descaling, sanding, wire brushing, and grinding.
 - 2) Before power tool cleaning, remove visible oil, grease, soluble welding residues, and salts by the methods outlined in SSPC-SP 1.
- d. White Metal Blast Cleaning (SW-16, SSPC-SP5 or NACE 1):
 - 1) When viewed without magnification, surface shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Removal shall be by blast cleaning with wheel or nozzle (dry or wet) using sand, grit, or shot.
 - 2) Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP 1 or other agreed upon methods.
- e. Commercial Blast Cleaning (SW-17, SSPC-SP6 or NACE 3)
 - 1) Removal of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter such that staining shall be limited to no more than 33% of each square inch of surface area and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied paint.
 - 2) Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP 1 or other agreed upon methods.
- f. Brush-Off Blast Cleaning (SW-18, SSPC-SP7 or NACE 4)
 - 1) When viewed without magnification, surface shall be free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose paint. Tightly adherent mill scale, rust, and paint may remain on the surface.

- 2) Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP 1 or other agreed upon methods.
- g. Power Tool Cleaning to Bare Metal (SW-19, SSPC-SP11)
 - 1) Metallic surfaces that are prepared according to this specification, when viewed without magnification, shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxide corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portions of pits if the original surface is pitted.
 - 2) Prior to power tool surface preparation, remove visible deposits of oil or grease by any of the methods specified in SSPC-SP 1 or other agreed upon methods.
- h. Near-White Blast Cleaning (SW-20, SSPC-SP10 or NACE 2)
 - 1) When viewed without magnification, surface shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except for staining.
 - 2) Staining shall be limited to no more than 5% of each square inch of surface area and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied paint.
 - 3) Before blast cleaning, visible deposits of oil or grease shall be removed by any of the methods specified in SSPC-SP 1 or other agreed upon methods.
- i. Water Blasting (SW-21, NACE Standard RP-01-72)
 - 1) Removal of oil grease dirt, loose rust, loose mill scale, and loose paint by water at pressures of 2,000 to 2,500 psi at a flow of 4 to 14 gallons per minute.
- j. All components of new equipment that can be properly prepared and coated after installation shall be installed prior to surface preparation. Components of equipment that will be inaccessible after installation shall have the surfaces prepared for coating prior to installation. Motors, valve actuators, drive mechanisms, bearings, electrical equipment, and panels, etc. shall be protected during surface preparation in accordance with the equipment manufacturer's recommendations.

3.04 PROTECTION

- A. Contractor shall cover or otherwise protect finish work or other surfaces not being coated within the scope of this Section. Contractor shall erect and maintain protective tarps, enclosures and/or masking to contain debris, including dust or other airborne particles from surface preparation or application activities. This may include the use of dust or debris collection apparatus as required at no additional cost to Owner.
- B. Protect elements surrounding the Work of this Section from damage or disfiguration.
- C. Repair damage to other surfaces caused by Work of this Section.
- D. Furnish and utilize drop cloths, shields, containment, and other necessary protective methods to prevent blast media, fumes, overspray, or droppings from disfiguring other surfaces.
- E. The Contractor shall maintain explosion-proof ventilation during surface preparation, coating operations, and curing periods in compliance with OSHA.
- F. Remove empty paint containers from site. Do not deposit in Owner receptacles for disposal. This includes empty containers, drop cloths, and other miscellaneous painting items.

3.05 APPLICATION

- A. Apply products in accordance with manufacturer's instructions. Use application equipment, tools, pressure settings, and techniques in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform finish.
- D. Apply each coat of paint slightly darker than preceding coat, unless otherwise approved.
- E. Sand lightly between coats to achieve required finish.
- F. Allow applied coat to dry before next coat is applied.
- G. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
- H. Do not use mixed coatings beyond pot life limit.

- I. Apply each coat to uniform finish and free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- J. Stripe paint with brush at critical locations on steel such as welds, corners, and edges using specified primer.

3.06 CLEANING

- A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
- B. During progress of Work, maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers, and remove daily from site. Do not deposit in Owner receptacles.
- D. At the completion of the Work, Contractor shall remove all materials and debris associated with the Work of this Section.
- E. Clean all surfaces not designated to receive protective coating that was affected by the Work of this Section. Restore all other work in a manner acceptable to the Engineer.
- F. All finished protective coating shall be protected from damage until Final Acceptance of the Work. Protective coating damaged in any manner shall be repaired or replaced at the discretion of the Engineer, at no additional cost to Owner.

3.07 FIELD QUALITY CONTROL

- A. Test questionable coated areas as directed by Engineer. Inspection by the Engineer or others does not absolve the Contractor from his responsibilities for quality control inspection and testing as specified herein or as required by the Manufacturer's instructions.
- B. Check for holidays on interior steel immersion surfaces using holiday detector per NACE Standard SPO-188-90 - Recommended Practice for Discontinuity (Holiday) Testing of Non-Conductive Coatings over a Conductive Substrate.
- C. Verify coatings and other materials are as specified.
 - 1. Inspect all materials upon receipt to ensure that all are supplied by the Approved Manufacturer.
- D. Verify surface preparation and application are as specified.

- E. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges.
 - 1. Wet-Film Thickness shall be taken every 100 square feet (9 square meters) in accordance with ASTM D 4414 and recorded.
 - 2. The Dry-Film Thickness may be determined using a surface area calculation for material consumption if applying to a non-conductive substrate.
 - 3. A factory calibrated Type 2 DFT gauge, either Positector 6000 or Elcometer 456, must be provided onsite by the Applicator and available for DFT verification for the Owner or Engineer. The gauge must be calibrated within the last year and records should be available onsite. If one is unavailable the Owner or Engineer may purchase a gauge at the Contractor's expense.
- F. Verify curing of the coating materials in accordance with the Manufacturer's Instructions.
- G. Contractor is responsible for keeping the Engineer informed of all progress so that Engineer may provide additional quality control at their discretion.

3.08 SHOP PRIMED ITEMS

- A. Refer to applicable Specification Sections for shop primed and pre-finished surfaces.

3.09 PAINT SCHEDULE REQUIREMENTS

- A. General Painting Requirements: In general, all new and modified existing structures and items, including but not limited to the following surfaces, shall be painted, unless otherwise noted.
 - 1. Exterior, interior, and submerged ferrous metals.
 - 2. Galvanized surfaces, except seat angles and grating.
 - 3. Paint shop-primed equipment and fixtures.
 - 4. Prime and paint all visible surfaces of new process pipes, valves, fittings, hangers, brackets, collars, and supports, except where items are prefinished.
 - 5. Concrete walls and floors. Refer to Section 09 96 00 - High Performance Coatings.
 - 6. Paint discharge heads and base plates of all new pumps.
 - 7. Prime and paint all new unburied exterior and interior steel, ductile iron, galvanized, and/or PVC piping.
 - 8. Replace identification markings on mechanical or electrical equipment when painted accidentally.

9. Paint exposed conduit and electrical equipment occurring in finished areas.
 10. Paint both sides and edges of plywood backboards for electrical equipment before installing equipment.
 11. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.
 12. Paint all raised curbs and tripping hazards safety yellow.
- B. The following surfaces shall not be painted, unless otherwise shown on the Drawings.
1. Stainless steel.
 2. Fiberglass or alluminum ladders and miscellaneous FRP or aluminum items.
 3. Hot dipped galvanized pipe supports.
 4. Prefinished items, unless noted otherwise.

3.10 PAINTING SYSTEM

- A. Exposed steel water piping within the pump station and valve vaults shall be coated with the following coating system.
1. Preparation:
 - a. Prep to white metal sand blasting per this section
 2. Prime Coat:
 - a. Thickness: 7.0 mils wet and 5.0 mils dry
 - b. Minimum drying time: 16 hours at 70°F or 30 hours after 50°F
 3. Top Coat:
 - a. Thickness: 7.0 mils wet and 5.0 mils dry
 - b. Minimum drying time: 20 hours at 70°F or 40 hours after 50°F
 - c. Final coating system thickness: 10 mils minimum
 4. Manufacturer and Product
 - a. Primer: Ameron Series Amerlock 400
 - b. Top Coat: Ameron Series Amerlock 400. Color: Selected by Owner
- B. General Painting Schedule

SYSTEM	SURFACE TO BE PAINTED	NOTES (3.1)	PRIME COAT CODE #	FIRST COAT CODE #	SECOND COAT CODE #
<u>Ferrous Metals</u>	Exterior	1	P1	P2	P3
FM-A	Exposure	1,2	P1	P2	P2
FM-B	Interior	3	--	P6	P6

FM-C	Exposure Immersion				
<u>Galvanized Steel & Nonferrous Metals</u> NF-A NF-B NF-C	Exterior Exposure Interior Exposure Immersion	2 2 4	P1 P1 P6	P3 P2 P6	-- -- --
<u>Steel</u> S-A S-B S-C S-D	Exterior Exposure Interior Exposure Immersion Solids Contact Clarifier	5 5 5 5	P1 P1 -- P7	P2 P2 P6 P6	P3 -- P6 P6
<u>Factory Primed Steel / Ductile Iron / Prefinished Items</u> FPS-A FPS-B	Exterior Exposure Interior Exposure Immersion	13 13 13	P7* P7* P7*	P2 P2 P6	P3 P2 P6
<u>Concrete</u> C-A C-B C-C C-D C-E	Interior Exposure Interior WTP Floors Interior Masonry Fluoride Room Floors Per Plans	4, 15 10 8, 14 10	-- P4 P5 P8 or P9 P10	P2 P4 P2 P8 or P9 P10	P2 P4 P2 P8 of P9 P10
<u>Miscellaneous</u> MI-A	PVC Piping	11	--	P2	P2
<u>Specialty</u>					

Coating Systems Fluid Applied Insulation Coating	See Drawings for Locations	Section 09 96 72	Section 09 96 72	Section 09 96 72	Section 09 96 72
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**Reference 3.01.B for compatibility test with prefinished Items.*

*** Multiple passes at timed intervals are required to achieve recommended dry film thickness. Curing time for film thickness will be at least 14 days.*

3.11 COATING PRODUCTS

PAINT PRODUCT CODE NUMBER	GENERIC NAME	PRODUCT	REQUIRED DRY FILM THICKNESS (MILS)
P1	Epoxy Polyamide	Macropoxy 646 Fast Cure Epoxy, B58-600 Series Tnemec Series N69 or 66HS	3.0-5.0/coat
P2	Epoxy Polyamide	Macropoxy 646 Fast Cure Epoxy, B58-600 Series Tnemec Series N69 or 66HS	4.0-6.0/coat
P3	Acrylic Polyurethane	Hi-Solids Polyurethane - color, B65-300 Series Tnemec Series 1075	3.0-5.0/coat
P4	Resinous Flooring System	Tnemec Series 224 Deco-Fleck, Decorative Mosaic System.	See Manufacturer Reccomendations for system
P5	Epoxy Polyamide	Macropoxy 646 Fast Cure Epoxy, B58-600 Series Tnemec Series N69 or 66HS	8.0/coat
P6	Epoxy Polyamide, NSF Coating	Macropoxy 646 PW Epoxy - white, B58WX600 Series Tnemec N140 or 20HS	4.0-6.0/coat

PAINT PRODUCT CODE NUMBER	GENERIC NAME	PRODUCT	REQUIRED DRY FILM THICKNESS (MILS)
P7	Factory Primed		
P8	Vinyl Ester Coating (Tnemec System)	Resurfacer: Series 215 Epoxy Surfacer or Series 218 MortarClad Prime Coat: Series 201 Epoxoprime Liner: Base Coat: Series 239SC ChemBloc with embedded 3/4 ounce fiberglass reinforcing mat. Saturant Coat: Series 239SC ChemBloc resin Finish Coat: Series 282 Tneme-Glaze	Prime Coat: 4.0- 12.0 mils/coat Liner: 60-80 mils/coat Saturant Coat: 8.0-12.0 mils/coat Finish Coat: 4.0- 12.0 mils/coat
P9	Vinyl Ester Coating (Sherwin Williams System)	Resurfacer: Steel Seam FT910 Epoxy Resurfacer Prime Coat: Corobond 100 Epoxy Primer/Sealer Liner: Intermediate Coat: Cor-Cote	Prime Coat: 4-6 mils/coat Liner: 15-20 mils/coat Finish Coat: 15- 20 mils/coat

PAINT PRODUCT CODE NUMBER	GENERIC NAME	PRODUCT	REQUIRED DRY FILM THICKNESS (MILS)
		HCR FF Finish Coat: Cor- Cote HCR FF	

* For Systems P8 & P9 - For further assistance, contact a Sherwin Williams or Tnemec Representative.

3.12 NOTES FOR PAINTING SCHEDULE

A. The following notes apply, as noted in the table, to the general painting schedule:

1. Spot prime shop-primed surfaces.
2. Prime non-shop-primed surfaces.
3. Contact paint supplier representative for recommended surface preparation.
4. SSPC-SP1 followed by brush off blast. Clean and dry surface.
5. SSPC-SP6. Clean and dry surface.
6. SSPC-SP10. Clean and dry surface.
7. Block filler.
8. Allow mortar to cure for 28 days. Level protrusions and mortar splatter and thoroughly clean.
9. Brush off blast. Clean and dry surface.
10. Shot blast, abrasive blaster, or mechanically abrade. Clean and dry surface.
11. Scarify surface, wipe to remove dust.
12. Sand rough areas. Seal knots and pitch pockets. Fill cracks and nail holes after primer is dry.
13. Clean and dry surface.
14. Allow new concrete to cure 28 days. SSPC-SP13/NACE 6, ICRI CSP 2-3 surface prep.
15. Contractor to grout fill holes on cast in place concrete. See Concrete specifications for allowable imperfections.

END OF SECTION

DIVISION 10 SPECIALTIES

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SECTION 10 01 00
TANK RETROFIT AND REHABILITATION

PART 1 GENERAL

1.1 SUMMARY

The following water storage tank rehabilitation and retrofit scope of work are outlined in this specification section. This work shall be performed by the pre-qualified specialty tank contractor, and corresponds to Bid Item No. 4.

A. Tank Inlet/Outlet and Overflow Modification

- i. Furnish all design, labor, materials, equipment and incidentals and prepare tank to have new 30" inlet/outlet pipe and 30" overflow pipe to be installed through existing floor.
- ii. Work of this bid item includes, but is not limited to, the following:
 - 1. Drain the tank and sediment removal (by Owner)
 - 2. Determine the location for new pipe and excavate the soil at determined location, exposing the footing of the tank.
 - 3. Remove and abandon existing interior overflow pipe.
 - 4. Excavate under the tank. Adequate support must be provided under the tank to uphold overall structural integrity, in order to prevent damage to the tank foundation and floor.
 - 5. Core holes through the existing floor where pipe penetrations are required.
 - 6. Install reinforced concrete curb around pipe openings with sizing and reinforcement as required by design performed by tank specialist. Install waterproofing around pipe openings/concrete curb.
 - 7. Install new piping, proper fittings, and pipe supports as required by design furnished from tank specialist.
 - 8. Encase new pipe underneath existing floor/footing with concrete.
 - 9. Pipe shall extend 5'-0" outside of exterior footing for connection by others.
 - 10. Backfill soil around the tank and restore site. (by others)

B. Interior Tank Repairs and Upgrades

- i. Furnish all labor, materials, equipment and incidentals required to perform miscellaneous repairs and upgrades on existing prestressed concrete tank.
- ii. Work of this bid item includes, but is not limited to, the following:
 - 1. Perform repairs on the underside of concrete dome at locations with existing spalled concrete. Assumed quantity

shall include ten (10) locations at two square feet per spot. Repairs shall include removal of unsound concrete and application of corrosion inhibitor and high-strength repair mortar.

2. Removal and replacement of existing interior steel ladder. New interior ladder shall be furnished with FRP and installed with adequate anchorage into existing prestressed wall.

C. Exterior Tank Upgrades

- i. Furnish all labor, materials, equipment and incidentals required to perform upgrades on exterior of prestressed concrete tank.
- ii. Work of this bid item includes, but is not limited to, the following:
 1. Install additional downspout drainage piping on exterior of tank to help promote drainage. Scope shall include coring holes through existing concrete curb and furnishing and installing similar aluminum drainage to match existing. Up to four (4) additional downspouts shall be installed at location directed by owner.
 2. Remove existing vent and replace with new 24" vent.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM C150 – Standard Specification for Portland Cement.

B. American National Standards Institute (ANSI)

1. ANSI B1.1 – Unified Inch Screw Threads (UN and UNR Thread Form).
2. ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
3. ANSI B18.2 – Square and Hex Bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws.

C. American Water Works Association (AWWA)

1. AWWA C104 – Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110 – Ductile-Iron and Gray-Iron Fittings, 3-in Through 48-in (75mm Through 1219mm) for Water.
3. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron or Gray-Iron Threaded Flanges.
4. AWWA C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast for Water.
6. AWWA C153 – Ductile-Iron Compact Fittings for Water Service.
7. AWWA C651 – Disinfecting Water Mains.
8. AWWA D110 Standards for Water Tanks

- D. American Concrete Institute (ACI)
 - 1. AWWA C651 – Disinfecting Water Mains.
 - 2. ACI 301-89, Specification for Structural Concrete for Buildings.
 - 3. ACI 30-92, Standard Practice for Curing Concrete.
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Specialty Tank Contractor shall provide stamped drawings of proposed pipe penetrations, including design for temporary support for excavation underneath floor, interior reinforced concrete curb at penetration locations
 - 2. Support system details for the under-tank excavation.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Follow all methods as recommended by the manufacturer.

1.5 QUALITY ASSURANCE

- A. The contractor shall be a specialist tank contractor experienced in the design, construction, and rehabilitation of AWWA D-110 tanks, having rehabilitated, in their own name, at least 10 tanks in the last 10 years of equal size or greater, five (5) of which have been in successful service for a minimum of five (5) years, and shall have restored at least five (5) tanks with deteriorated concrete / shotcrete walls and or domes within the last five (5) years at least three (3) of which required the re-tensioning of and or replacement of damaged prestress wire. In addition, the specialist tank contractor shall have performed five (5) projects that include a pipe penetration on an AWWA D110 tank, through the wall, floor, or roof.
- B. The specialty tank contractor shall have in its employ a design engineer, licensed in the State of Utah, with design experience for construction and rehabilitation of AWWA D110 prestressed concrete tanks. The licensed engineer shall have designed a minimum of ten (10) AWWA D110 prestressed concrete in the last ten (10) years.
- C. Singular Responsibility: The scope of work outlined in this specification (pipe penetration, excavation underneath floor, concrete restoration, etc) shall be performed by skilled personnel employed directly by specialty tank contractor.
- D. DN Tanks Inc., is a pre-qualified tank contractor for this project.

- E. Inspection of the pipe and fittings will also be made by the Engineer or representative of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the specified requirements, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Pipe & Fittings
 - 1. Materials for the piping, joints, and fittings shall be as specified in other related sections or as shown in the pipe schedule on the contract drawings.
 - 2. Pipe and appurtenances shall comply with the applicable standards for this type of material.
- B. Patching Material
 - 1. Patching material: Thorite by Thoro System Products, Speedcrete Redline, Tamms Patch II, Tamms Spray Mortar by Euclid Chemical Company or other approved equal.
 - 2. Concrete material: In accordance with AWWA D110, ACI 301 or other approved equal.
 - 3. Patching material: Thorite by Thoro System Products, Speedcrete Redline, Tammspatch II, Tamms Structural Mortar by Euclid Chemical Company or other approved equal.
 - 4. Concrete material: Crack Resistant Concrete Mix by Quikrete, Eucocrete by Euclid Chemical Company, or approved equal.
 - 5. Shotcrete material: Wet or dry mix in accordance with AWWA D110, ACI 301 & 506R or other approved equal.
 - 6. Anti-corrosion Reinforcing Primer: ECB by Conproco, Dural Prep AC by Tamms, or other approved equal.
 - 7. Replacement Reinforcement: welded steel wire fabric conforming to ASTM A185, galvanized.
 - 8. Replacement Reinforcement Anchors: ¼ in. x 1 ½ in. stainless steel expansion anchors or stainless steel concrete anchor screws as manufactured by the Rawlplug Co., Inc., New Rochelle, NY 10802, WEJ-IT, Tulsa, OK 74152, Hilti, Tulsa, OK 74121, Tapcon, or other approved equal.
- C. Reinforcing
 - 1. Reinforcing bars shall comply with ASTM A615, Grade 60.
- D. Injection Grout
 - 1. HA Flex LV by deNeef Construction Chemicals, Inc., Waller, TX.

2. SikaFix HH by Sika Corporation, Inc., Lyndhurst, NJ.
 3. AV-202 Multigrout by Avanti International, Webster, TX.
 4. Or equivalent.
- E. Interior Ladder
1. Interior Ladder shall be NSF 61 approved fiberglass extending from dome hatch to tank floor.
 2. Access ladder shall have a fall prevention device meeting OSHA standard.
- F. Center Dome Vent and Screen
1. New vent shall be 24", with aluminum 24 x 24 insect (No. 4) screen mounted on new reinforced concrete curb in accordance with shop drawings.
 2. Caulking for the center dome vent shall be an NSF approved one part silicone sealant that meets or exceeds the requirements of the following specification standards: Federal Specifications TT-S-001543A Class A (COM-NBS) for silicone building sealants, and TT-S-00230C Class A (COM-NBS) for one-component sealants; ASTM 920.
- G. Drainage Downspouts
1. Exterior drainage downspouts shall be manufactured and furnished with aluminum material to best match existing drainage on existing structure.
- H. Interior Waterproofing Coating
1. Interior waterproofing shall be applied on interior concrete curbs at penetration locations, as shown on details.
 2. Coating material shall be C.I.M. 1061, a high solids, two component liquid, cold applied, asphalt extended urethane elastomer that cures to a durable abrasion resistant film and forms a flexible, impermeable barrier to water, as manufactured by C.I.M. Industries Inc., or approved equal.
 - i. Coating material shall comply with NSF61 criteria for direct contact with potable water.
 - ii. Minimum thickness: 60 mils. wet film / 55 mils. dry film
 - iii. Maximum coverage: 26 sq. ft. per gal.
 - iv. Solids by volume: 88 percent
 - v. Volatile Organic Compounds (VOC): 0.75 pounds per gallon
 - vi. Elongation: 350 percent
 - vii. Patching material for treatment of cracks shall be trowel grade C.I.M. 1000 Trowel Grade. Liquid applied, chemical and corrosion resistant urethane elastomer, chemically thickened to allow trowel application with minimum sag.

PART 3 EXECUTION

3.1 PIPE PENETRATION EXECUTION

- A. Determine and layout the location and orientation of the new 30" inlet/outlet and overflow pipes in the field.
- B. General Contractor shall be responsible for performing excavation at designated penetration locations, to a depth required for specialty tank contractor. The excavation shall expose the footing at the designated locations. Use caution to not undermine the tank foundation system.
- C. Excavate beneath the tank foundation and floor to allow for installation of new proposed 30" pipes and fittings. The tank floor and foundation must be supported by a temporary engineered shoring system to ensure no damage to the tank.
- D. The temporary support system shall be designed and stamped by a registered Professional Engineer in the State of Utah, employed by the specialty tank contractor.
- E. Remove and abandon existing interior pipe in accordance with engineers standards and specifications.
- F. Penetrate the tank floor to allow installation of new piping. Tank floor shall be fully supported before any penetrations are made.
- G. Install new piping and fittings as indicated on approved shop drawings.
- H. Reinforce and form the new pipe encasement as indicated on the contract drawings. Replacement reinforcing shall be of proper size and be installed with proper laps.
- I. Concrete encase the new pipe with approved concrete mix.
- J. Cure the new encasement prior to removal of the forms. Confirm proper concrete strength with test samples taken by and tested by an independent test agency.
- K. Pipe shall extend beyond existing footing approximately 5'-0" for General Contractor to make necessary connections.

3.2 CONCRETE RESTORATION

- A. Removal of Unsound Shotcrete / Concrete
 - 1. Remove loose and unsound shotcrete / concrete with appropriate chipping hammer to sound shotcrete with a minimum depth of 3/8 in. over the complete repair area, except do not cut any sound (substantially uncorroded) mesh reinforcing.
- B. Surface Preparation
 - 1. Clean the surface by removing any dust, unsound or contaminated material, laitance, and corrosion deposits. Clean loose corrosion

deposits from exposed reinforcing. Where chipping is not required to remove unsound material, roughen the surface and remove any laitance by light scrubbing. High-pressure wash with clean water, at a minimum pressure of 3,500 psi, prior to priming exposed reinforcing and substrate.

- C. Install replacement reinforcement wire mesh in all patching areas where existing reinforcing is no longer present.
 - 1. Reinforcement shall consist of a single piece over the full extent of the patch.
 - 2. Reinforcement shall be lapped over and tied to existing reinforcement where it is practical to expose existing reinforcing without damaging it.
 - 3. When adjacent existing reinforcing cannot be exposed without damage, anchor new reinforcing to existing concrete with expansion anchors, spaced approximately 16 inches on center with a minimum of 4 anchors per patched area.
- D. Prime exposed existing reinforcing steel by applying one full coat of approved priming material. Allow to dry before applying patching. If any doubt exists about having achieved an unbroken coating, a second application shall be made and, again, allowed to dry before applying patching.
- E. Prime substrate after it is saturated surface dry (i.e.: thoroughly soaked with clean water and any excess water removed) with a slurry of the repair mortar in accordance with the manufacturer's directions. Using a stiff mason's brush, the slurry shall be scrubbed into the substrate where access is not impeded by new wire mesh reinforcing. The repair mortar shall be installed as soon as the slurry becomes tacky and before it dries.
- F. Mix patching mortar in strict accordance with manufacturer's directions. Use only material from original bags and containers.
- G. Application of patching mortar.
 - 1. Exposed steel reinforcing bars and welded wire fabric shall be firmly secured to avoid movement during the application process, as this will affect mortar compaction, build and bond.
 - 2. Apply the patching mortar to the prepared substrate by gloved hand or trowel. First, work a thin layer of the mortar into the slurry and then build the mortar onto this layer. Thoroughly compact the mortar onto the primed substrate and around the exposed reinforcement.
 - 3. Apply the patching mortar in strict accordance with the manufacturer's directions.

- 4. If sagging occurs during applications, the patching mortar shall be completely removed and reapplied at a reduced thickness onto the correctly re-primed substrate.
- H. Finish the patching mortar by striking off with a straight edge and closing with a steel float. Finish of the shotcrete surface shall be a nozzle or gun finish. The completed surface shall not be overworked.
- I. Low temperature conditions: In cold weather, normal precautions for winter when working with cementitious materials shall be adopted. The material shall not be applied when the substrate and/or air temperature is 45°F (7°C) and falling. At 45°F (7°C) static temperature or at 45°F (7°C) and rising, the application may proceed. Do not apply if the temperature is expected to fall below 45°F (7°C) within 24 hours of application. Comply with manufacturer's directions for cold weather applications.
- J. High temperature conditions at ambient temperatures about 80°F (26°C), the materials shall be stored in the shade. Comply with manufacturer's directions for hot weather applications.
- K. Water cure finished surfaces of patches using fine mist spray or wet burlap against surface for a minimum of seven (7) days after initial set of patch material.
- L. Cure finished surfaces of interior patches by method acceptable to owner.

3.3 INTERIOR LADDER

- A. Remove existing interior ladder and dispose.
- B. Furnish and install new FRP ladder. Installation of new FRP ladder shall be in accordance with manufacturer's requirements, as well as in accordance with shop drawings.
- C. Specialty Tank Contractor shall determine anchorage requirements for new interior ladder.

3.4 EXTERIOR LADDER

- A. Furnish and install new Stainless Steel Rigid Rail on the existing exterior ladder. Installation of new Stainless Steel Rigid Rail shall be in accordance with manufacturer's requirements, as well as in accordance with shop drawings.

3.5 EXTERIOR DRAINAGE UPGRADE

- A. Coordinate with General Contractor/Owner to determine proposed locations of desired concrete cored holes for new exterior roof drainage.
- B. Core hole through reinforced concrete curb.
- C. Furnish and install new aluminum drainage structures.

- D. Specialty Tank Contractor shall anchor exterior aluminum drainage to existing prestressed concrete tank wall in method that shall not damage existing prestressing.

3.6 EXTERIOR CENTER DOME VENT

- A. Remove existing center dome vent.
- B. Pour new concrete curb as required to accept new roof vent.
- C. Apply bead of silicone caulk to mating surfaces of the new fiberglass center dome vent and concrete vent curb.
- D. Install new fiberglass center dome vent and anchor securely to vent curb with appropriate fasteners.
- E. Apply bead of silicone caulk to vent flange, completely sealing flange to concrete vent curb to provide a watertight seal.

PART 4 BASIS OF PAYMENT

- A. Payment shall be based on the lump sum bid amount, for each bid item.

END OF SECTION

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DIVISION 23 HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

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SECTION 23 01 20
HVAC GENERAL PROVISIONS

PART 1 GENERAL

1.01 GENERAL CONDITIONS

- A. This section applies to and forms a part of each of the Sections of Division 23 and together with each Section, is subject to the following requirements:
 - 1. Instructions to Bidders
 - 2. General Conditions
 - 3. Supplementary General Conditions
 - 4. Division 01: General Requirements

1.02 RELATED SECTIONS

- A. Section 01 33 00 - Submittal Procedures

1.03 INCLUDED SECTIONS

- A. Section 23 01 30 - HVAC REMODELING PROVISIONS
- B. Section 23 01 55 - HVAC SITE CONDITIONS
- C. Section 23 01 70 - HVAC SUBMITTALS

1.04 SCOPE OF WORK

- A. The Work under this Division of the Specifications consists of furnishing all construction engineering, supervision, labor, equipment, fixtures, materials, all incidentals, related items and appurtenances, and performing all operations necessary to complete the installation of Work in strict accordance with these Specifications and Drawings.
- B. All work shall be finished, tested and ready for operation and use.
- C. The term "provide" shall mean "furnish and install complete and ready for use".

1.05 DISCREPANCIES OR OMISSIONS FROM SPECIFICATIONS OR DRAWINGS

- A. Notify the Engineer of any discrepancies in, or omissions from the Specifications or Drawings. The Owner's Construction Representative will not be responsible for any oral instructions or modifications of the Specifications or Drawings. Written interpretations will be made only by Addenda. Discrepancies discovered during construction shall immediately be called to the attention of the Construction Representative for decision.

1.06 DRAWINGS

- A. The Drawings indicate the extent and general layout of the Mechanical systems intended for the building. Furnish offsets, fittings, valves and accessories as required but not shown because of the scale of the Drawings.

- B. In general, the Mechanical Drawings are drawn to scale as indicated, however, do not scale the Mechanical Drawings. Refer to the Architectural Drawings for dimensions, details of construction, locations of partitions, walls, suspended ceilings, ceiling heights and other pertinent information. Architects Drawings shall not take precedence over field measurements.
- C. Coordinate Work with the work of other trades. Make reasonable modifications in layout to avoid conflict with the work of other trades and for proper execution of the Work at no additional cost to the Owner.
- D. All Drawings and Specifications shall be considered in bidding. The Drawings and Specifications are complimentary, and what is called for in either shall be as binding as though called for in both.

1.07 SUBSTITUTION REQUESTS

- A. Refer to Section 01 33 00 - Submittal Procedures, for proper procedures on product and equipment substitutions.

1.08 INSPECTION OF SITE

- A. Contractor shall inspect the site of the proposed Work and note the conditions under which the Work is to be performed.

1.09 PERMITS AND FEES

- A. Contractor shall obtain all permits required for the performance of the Mechanical Work and shall submit complete certified Drawings and Specifications with the permit application to the authority having jurisdiction.
- B. Contractor shall pay for all sales tax, fees, licenses, permits, charges for connection to outside services, use of property for storage of materials and other costs pertaining to the Mechanical Work.
- C. Contractor shall coordinate and request all inspections and approvals as required. Contractor shall notify the Owner's Construction Representative of date and time of all coordinated inspections and shall submit certificates of inspection and final approval of the inspection authority.

1.10 APPLICABLE CODES AND STANDARDS

- A. Construction shall be in conformance with the latest amended edition of the State Building Code, including requirements of other codes, standards and regulations adopted by reference as a part thereof. Contractor shall comply with any requirements of the Drawings and Specifications that exceed the State Building Code requirements.
- B. All materials, equipment and their installation shall conform to the applicable sections of the following current Codes for the State of Utah:
 - 1. International Building Code, IBC 2021.
 - 2. International Mechanical Code, IMC 2021.
 - 3. International Plumbing Code, IPC 2021.
 - 4. International Fuel Gas Code, IFGC 2021.
 - 5. International Fire Code, IFC 2021.

1.11 WORKMANSHIP

- A. All the Work shall be performed in a craftsmanship manner by workmen thoroughly trained and experienced in the Work they are to perform.
- B. Refer to Specification Section 23 01 55 - HVAC Site Conditions and Section 23 01 60 - HVAC Piping Procedures for further direction.

1.12 ACCIDENT PREVENTION

- A. Comply with the "Safety and Engineering Practices" set forth in the "Manual of Accident Prevention in Construction" published by the Associated General Contractors of America and with all applicable state and local safety laws, regulations and ordinances as well as the Owner's established safety rules.
- B. Provide and properly maintain warning signs and lights, barricades, railings and other safeguards for the protection of workmen and others on, about or adjacent to the work as required by the conditions and progress of the Work.

1.13 SITE AND BUILDING CLEANLINESS

- A. During construction, provide for orderly storage and removal of all construction debris, cartons, packing cases and other such items in a manner to reduce fire and accident hazards.
- B. Contractor shall clean the working area each day and shall remove all trash and waste materials, and shall maintain the Site in a neat and orderly condition throughout the construction period.
- C. Contractor shall daily, or as it becomes apparent, pick up all garbage, litter, debris and other materials attributable to the Work or the activities of Contractor's employees, Sub-Contractors and suppliers that accumulates on the property in the vicinity of the Site.

1.14 WORK SCHEDULE

- A. Examine the Drawings and Specifications to determine the extent and details of the Work to be performed.
- B. Submit a construction work schedule for approval to the General Contractor.
- C. The schedule must be suitable to all parties concerned.
- D. The schedule shall be a guide to construction operations and progress shall conform, as nearly as possible to the schedule. Notify the General Contractor at least one week in advance of any changes to the schedule.
- E. Be responsible for scheduling and arranging all Mechanical work for the orderly progress of the project.

1.15 COORDINATION OF WORK

- A. Coordinate the Mechanical Work with the General Contractor and other Sub-Contractors.
- B. Inform the General Contractor at least twenty-four (24) hours in advance of any service interruption or disruption to construction operations and

estimate the duration of interruption or disruption. Do not proceed until the General Contractor has been fully informed and has granted his approval.

1.16 RECORD DRAWINGS

- A. Contractor shall maintain one set of Drawings at the job site for use as a record copy. Each change order or other revisions, deletions, or additions, shall be clearly marked and noted by colored marker. Where any material, ductwork, piping or system component is installed different from what is shown on the Construction Documents, record such differences clearly and neatly. This record set of Drawings shall be submitted to the Owner's Construction Representative upon completion of the project.

1.17 SUBMITTALS

- A. The submittals shall be issued electronically. The equipment manufacturer shall submit one (1) copy of Submittals to the Contractor. The Contractor will review, stamp, and send to the Engineer for review. The Engineer will retain reviewed copies for his files and forward copy to the Architect, Owner of the final submittal, and to the Contractor to be incorporated into the Maintenance & Operating Instructions Manuals.
- B. Manufacturer's standard dimension drawings, performance and product data shall be edited to delete reference to equipment, features or information which is not applicable to the equipment being supplied for this project.
- C. All shop drawings must be reviewed and accepted by the Engineer prior to fabrication and installation.
- D. Provide sufficient copies of approved data with the Engineers approved stamp for inclusion in the Operation and Maintenance Manuals as specified in this Section.
- E. Submittals on all equipment shall be submitted for approval with-in one month of Contract award.
- F. Shop Drawings will not be accepted for review by the Architect/ Engineer until after they have been checked and approved by the Contractor as evidenced by his approval stamp and signature.
- G. Where the Specifications state "or equal" or "or approved equal", manufacturers other than those listed may be substituted in accordance with Section 01 25 00 - Substitution Procedures.
- H. In addition to the hard paper copy shop drawing, supply one (1) copy of the maintenance shop drawing and maintenance data for the respective equipment on electronic format.
- I. Allow a minimum of fourteen (14) calendar days for the Engineer to review the shop drawings. Time is from the receipt of drawings in the Engineers office until they are shipped out of the office.
- J. If the Engineer rejects (Make corrections as noted/Submit Specified Item, Rejected/Submit specified item) two (2) times for the same section the

Engineer will be compensated for the additional reviews. Compensation will be incorporated by Change Order and deducted from the Contractor's application for payment. Contractor is responsible for delays caused by the re-submittal process.

1.18 COMPLETION

- A. The Work shall be completed for service on the date stipulated in the Contract.
- B. Correlate and finish the Work so that the affected areas and systems will be adjusted, cleaned and placed in proper working order at the time of the substantial completion observation.
- C. Prior to final inspection, thoroughly clean the surfaces of all floor drains, fixtures and equipment furnished and installed under this Work. Refer to Section 23 01 70 - HVAC Submittals for further direction.

1.19 WARRANTIES

- A. Submit two (2) copies of the Warranty Manual in accordance with Section 01 77 00 - Closeout Procedures and Section 23 01 70 - HVAC Submittals.
- B. Refer to technical sections for extended warranties on equipment where stipulated.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION

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SECTION 23 01 30
HVAC REMODELING PROVISIONS

PART 1 **GENERAL**

1.01 APPLICABILITY

- A. This Section covers HVAC remodeling provisions and applies to and forms a part of each of the following Sections of Division 23:
 - 1. Section 23 07 00 - HVAC INSULATION
 - 2. Section 23 90 00 - HVAC CONTROLS
- B. HVAC remodeling shall be in accordance with this and other applicable Sections of these Specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS.

1.02 DISCOVERY OF ASBESTOS

- A. During the course of Work, if the Contractor observes the existence of asbestos pipe insulation, the Contractor shall promptly notify the Owner and Architect/ Engineer in writing and by telephone. Owner shall consult with the Architect/ Engineer regarding appropriate procedure to be taken, and the Contractor shall not perform any work pertinent to the asbestos material.

PART 2 PRODUCTS NOT USED

PART 3 **EXECUTION**

3.01 FIXTURES AND EQUIPMENT TO BE REMOVED

- A. Remove only the existing fixtures and equipment indicated on the Drawings to be removed. All other existing fixtures and equipment shall remain as is.
- B. The Owner shall retain the right to keep certain fixtures and equipment that are removed. The Mechanical Contractor shall remove from the premises and properly and legally dispose of those fixtures and equipment the Owner chooses not to keep and all piping and ductwork to be removed under the Work.

3.02 REMODELING CONDITIONS

- A. Only where indicated on the Drawings are existing services to be removed, relocated or connected under Division 23. All other existing services shall remain as is.
- B. Work that interrupts any service, including cutting into existing lines for new connections, shall be performed so as to minimize interruption of service and disruption to building operations. Anticipate work during abnormal hours. These off-hours labor costs shall not result in additional cost.
- C. Schedule with the Owner two (2) weeks in advance of any shut off necessary, time of shut-off and estimated duration. Only after the Owner

has been fully informed, and has agreed to the scheduled shut-offs, can the Work prompting the shut-off then proceed.

- D. Connections to and relocation of existing piping systems, which of necessity must provide continuous uninterrupted service, shall be accomplished in the least possible time. Work shall be scheduled so as to minimize the down time for the respective systems involved. This will require that all interconnecting portions of these systems shall be installed as complete as practicable prior to actual shutdown for final connections.
- E. Locate existing piping and make connections where required and/ or where shown on the Drawings. Do not cut into an existing service without first ascertaining to the satisfaction of the Owner that the pipe involved is the correct service.
- F. At locations where new piping and/ or ductwork connects to existing, Contractor to verify existing conditions and be responsible for all alterations for such connections.

END OF SECTION

SECTION 23 01 55
HVAC SITE CONDITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Waste Management Procedures
- B. Cleaning and Protection.
- C. Final Cleaning.

1.02 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

- A. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- B. Methods of trash/ waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
- C. Regulatory Requirements: The Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, State and Local requirements, pertaining to legal disposal of all construction and demolition waste materials.

3.02 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/ rubbish from site periodically and dispose off-site; do not burn or bury.

3.03 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual Specification Sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.04 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- D. Provide new filters for all new equipment installed under this contract.
- E. Provide an extra set of filters for all new equipment installed under this contract. Coordinate with the Owner for placement.
- F. Clean debris from roofs, gutters, and drainage systems.
- G. Remove waste, surplus materials, trash/ rubbish, and construction facilities from the site; dispose of in a legal manner; do not burn or bury.
- H. Prior to final inspection, thoroughly clean surfaces of all floor drains, fixtures and equipment furnished and installed under this Work. Remove all stickers, rust, stains and other foreign matter or discoloration.

END OF SECTION

SECTION 23 01 70
HVAC SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Operation and Maintenance Data.
- B. Warranties and bonds.

1.02 RELATED SECTIONS

- A. Section 01 33 00 - Submittal procedures: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 77 00 - Closeout Procedures: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Submit two (2) copies of preliminary draft or proposed formats and outlines of contents before start of Work. The Engineer will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by the Owner, submit completed documents within ten (10) days after acceptance.
 - 3. Submit one (1) copy of completed documents fifteen (15) days prior to final inspection. This copy will be reviewed and returned after final inspection, with comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two (2) sets of revised final documents in final form within ten (10) days after final inspection.
- B. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with the Owner's permission, submit documents within ten (10) days after acceptance.
 - 2. Make other submittals within ten (10) days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond the Date of Substantial Completion, submit within ten (10) days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 OPERATION AND MAINTENANCE DATA

- A. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Type Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.02 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- C. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- D. Provide servicing and lubrication schedule, and list of lubricants required.
- E. Include manufacturer's printed operation and maintenance instructions.
- F. Include Sequence of Operation by controls manufacturer.
- G. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- H. Provide control diagrams by controls manufacturer as installed.
- I. Include test and balancing reports.
- J. Additional Requirements: As specified in individual product specification sections.

3.03 OPERATION AND MAINTENANCE MANUALS

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. Prepare data in the form of an instructional manual. Including step-by-step instructions for operating the equipment.
- C. Binders: Commercial quality, 8-1/2" by 11" three (3) D side ring binders with durable plastic covers; 2" maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Provide tabbed dividers for each separate product and system, with typed description of product and major component parts of equipment. At the beginning of each section, the equipment supplier's name, address and phone number shall be provided.
- F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by systems, in order, under section numbers and sequence of Table of Contents of this Project Manual.
- I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Contractors, Subcontractors and major equipment suppliers.
 - 2. Part 2: Operation and maintenance instructions arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:

- a. Shop drawings and product data. All data must clearly show model numbers, sizes and capacities of the equipment installed.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Photocopies of warranties and bonds.
 - e. Factory/ Facility start-up reports.
- J. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
- K. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of, Consultants, Sub consultants and names of responsible parties; schedule of products and systems, indexed to content of the volume.
- L. Operation and Maintenance Manuals shall be submitted to the Engineer for approval prior to final observation of the Work. The Engineer will forward approved Manuals to the Owner's Construction Representative.

3.04 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with the Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-executive submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Include originals of each in Operation and Maintenance manuals, indexed separately on a Table of Contents.
- F. Manual: Bind in commercial quality 8-1/2" by 11" three (3) D side ring binders with durable plastic covers.
- G. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of and equipment supplier; and name of responsible company principal.
- H. Table of Contents: Neatly typed, in the sequence of Table of Contents of the Project Manual, with each item identified with the number and title of the Specification Section in which specified, and the name of the product or work item.
- I. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets

as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

- J. This Contractor shall warranty all materials, equipment, workmanship and the successful operation of all apparatus furnished and installed under this contract for a period of one (1) year from the issuance of the final Certificate of Final Completion, except if noted otherwise. This Contractor shall guarantee to repair or replace at his own expense, any part of the apparatus which may show defect, in the opinion of the Architect or Engineer, due to imperfect material, equipment, or workmanship.
Individual warranties are as per manufacturer's standard unless extended warranties are specified. Copies of manufacturer's warranty for each piece of equipment shall be given to Owner.
- K. Refer to technical sections for extended warranties on equipment where stipulated.

END OF SECTION

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SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 APPLICABILITY

- A. This Section covers basic materials and methods and applies to and forms a part of each of the Sections of Division 23.
- B. The Work shall be in accordance with this and other applicable Sections of these Specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS.

1.02 RELATED SECTIONS

- A. The following Sections apply to and form a part of these Sections:
 - 1. Section 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
 - 2. Section 23 05 14 - COMMON ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT
 - 3. Section 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
 - 4. Section 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

1.03 QUALITY ASSURANCE

- A. The physical and chemical properties of all materials, design, performance characteristics and methods of construction of all equipment shall be in accordance with applicable current editions of the following Standards, references and guidelines:
 - 1. Underwriters Laboratories, Inc. (UL).
 - 2. National Fire Protection Association Standards (NFPA).
 - 3. American Society for Testing and Materials (ASTM).
 - 4. American Society of Mechanical Engineers (ASME).
 - 5. American Water/ Works Association (AWWA).
 - 6. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE).
 - 7. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
 - 8. Air Movement and Control Association (AMCA).
 - 9. Air Conditioning and Refrigeration Institute (ARI).
 - 10. National Environmental Balancing Bureau (NEBB).
 - 11. American Association of Balancing Contractors (AABC).
 - 12. Plumbing and Drainage Institute (PDI).
 - 13. American Society of Plumbing Engineers (ASPE).
 - 14. American Gas Association (AGA).
 - 15. American National Standards .
 - 16. National Electrical Manufacturers Association (NEMA).

17. Institute of Electrical and Electronic Engineers (IEEE).
18. Cast Iron Soil Pipe Institute (CISPI).
19. Plastic Pipe and Fittings Associations (PPFA).

1.04 DESIGN BASIS

- A. The design and the physical sizes of equipment shown to scale on the Drawings are based on the manufacturers and model numbers of equipment scheduled on the Drawings. The Scheduled equipment establishes the quality basis and performance required. The Drawings were prepared to show the service connections, minimum clearances and accommodations required for the scheduled equipment.
- B. If the Contractor elects to substitute equipment specified as "or equal" or "or approved equal", or to substitute equipment by other manufacturers where the manufacturer's name is added by addendum as "approved equal manufacturer", he/she shall be responsible for the space requirements, configuration changes in connections, bases, supports, vibration isolation, structural members, openings in structure and its relationship to other equipment and services that may be affected by its use. Contractor shall submit scale drawings to the Engineer to show how the substituted equipment will be accommodated including manufacturer's recommended clearances and servicing provisions.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 RECEIPT, HANDLING AND STORAGE

- A. Contractor shall be responsible for receiving delivery of the Mechanical materials, fixtures and/ or equipment.
- B. Provide personnel to meet all delivery trucks, inspect the equipment and sign for the delivery, unload the trucks and move the equipment to locations agreed upon in advance. Un-crate the equipment and properly dispose of all crating materials off-site.
- C. The Owner will not provide equipment, labor or handling assistance for this Work.
- D. If the materials, fixtures and/ or equipment must be stored on-site prior to installation, the Contractor shall move the material, fixtures and/ or equipment to the location designated and provide temporary protection against weather and physical damage as directed by the Owner's Construction Representative.

3.02 EQUIPMENT INSTALLATIONS

- A. Provide all necessary rigging, scaffolding, tools, tackle, labor, etc. necessary for the complete installation of the Mechanical equipment.
- B. Adapt the Work to the job conditions and install the Work so that beams, joists and light fixtures, etc. have clearance with Mechanical items. Adjust risers and avoid light fixtures. Raise or lower work to permit the

passing of ductwork of the work of other trades, all as required or as job conditions dictate, without additional cost to the Owner.

- C. All equipment shall be installed and connected with the best engineering practices and in accordance with the manufacturer's instructions and recommendations. Ductwork, piping, electrical connections, valves and appurtenances recommended by the manufacturer or as required for proper operation shall be furnished and install to complete the installation.
- D. All equipment shall be installed and located to facilitate accessibility for maintenance and/ or replacement.

3.03 EXCAVATING AND BACKFILLING

- A. Excavate and backfill as required to install underground piping, pipe conduits and/or ductwork. All the Work shall be carefully protected from injury due to frost, water or other causes and any work damaged shall be promptly and properly repaired. All underground work shall be inspected and approved prior to backfilling.
- B. Backfill around underground pipe conduits and/ or ductwork shall be done with sand or gravel, free from perishable material and excessive amounts of clay. If the natural earth material is of granular structure, as specified above, no additional material will be required. All buried services shall have a uniform bearing and shall be placed on undisturbed soil or compacted fill.
- C. Backfill up to 2'-0" of cover over piping shall be placed by hand and tamped, being careful not to damage the Work. Backfill above this point shall be placed and compacted to not less than 95 percent within building limits of maximum density given by ASTM D698-70T (Standard Proctor Density).
- D. Any dewatering required to install Mechanical Work shall be the responsibility of the installing Contractor.

3.04 WELDING

- A. All welding shall be performed by certified welders. Certification shall be for the type of work being performed and shall be accomplished in accordance with ASME "Qualification Standard for Welding Procedures, Welders and Welding Operations."
- B. Contractor shall submit copies of the welder's certification to the General Contractor's construction superintendent prior to any welds to be made by any welder.
- C. All welds shall be stronger than the parent metal. A minimum of two (2) passes shall be used on all arc welded joints.

3.05 CUTTING AND PATCHING

- A. Do all cutting and patching necessary for the installation of the Mechanical Work, except where otherwise indicated. All cutting shall be done in a manner directed by the General Contractor. Patching shall match adjacent surfaces.
- B. Do not cut structural members.

- C. Core drill all openings up to 10" in diameter.

3.06 ACCESSIBILITY

- A. Advise the General Contractor of spaces and clearances required to accommodate the Mechanical Work. Locate all equipment which must be serviced, operated or maintained in fully accessible positions.
- B. Floor, wall and ceiling access panels as required to service valves, controls, dampers, fire dampers and equipment will be provided under the general construction work.
- C. Coordinate required locations with the General Contractor.

3.07 PAINTING

- A. Mechanical Contractor shall touch-up the surface marring on all pre-finished Mechanical equipment to match existing factory finish.

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Single phase electric motors.
- B. Three phase electric motors.

1.02 RELATED SECTIONS

- A. Section 26 05 19 - POWER AND INSTRUMENTATION CABLE - LESS THAN 600V.
- B. Section 26 24 19 - MOTOR-CONTROL CENTERS.

1.03 REFERENCES

- A. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2006.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; 2016.

PART 2 PRODUCTS

2.01 MOTORS

- A. Furnish electric motors as required for each motor driven unit. All motors shall conform with applicable NEMA, IEEE and ANSI Standards and shall bear the manufacturer's nameplate indicating the operating characteristics.
 - 1. Motors shall be General Electric, Marathon, Westinghouse, Gould, or approved equal.
 - 2. All motors shall be provided with ball or roller bearings complete with grease cups. Motors shall be mounted on sliding cast iron bases as required.
 - 3. Each motor shall have sufficient capacity to start and operate the machine it drives without exceeding the motor nameplate rating at the specified speed including all V-Belt and/ or drive and coupling losses. Where V-Belt drives are employed, the motor horsepower nameplate ratings shall not be less than 107 percent of the driven unit brake horsepower requirements.
 - 4. All centrifugal pump motors shall be sized so as to be non-overloading throughout the flow range of the required pump impeller size.
 - 5. Each motor shall have a minimum 1.15 service factor rating or as scheduled in this Section of the Specifications.
 - 6. Motors shall be rated for continuous duty at 100 percent of rated capacity. Temperature rise shall be based on an ambient temperature of 40° C.
 - 7. Single phase motors shall be wound for 120 volts or 230 volts as specified, 60 cycle alternating current. Generally, motors 1/2

- horsepower and under shall be single phase. All such motors shall have integral thermal overload protection.
8. Motors 3/4 horsepower and larger shall be polyphase motors wound for 460 volt, 60 cycle, 3 phase alternating current.
 9. All motors 1 horsepower and larger, furnished separately or as part of equipment provided on this project, shall be high efficiency type NEMA Design B. The NEMA Nominal Efficiency Rating as stamped on the motor nameplate shall meet or exceed the efficiency as defined and listed in the latest edition of IEEE Standard 112 and NEMA MG1-12.53 a., b.
 10. Motors operated from variable frequency drives (VFD's) shall be suitable for VFD application and shall include a thermal switch in the windings with leads brought into the motor junction box.
- B. The horsepower of each motor Specified, Scheduled or indicated on the Drawings is the basis for the electrical feeder size indicated on the electrical drawings. If the actual horsepower for any equipment proposed to be furnished differs from that which was Specified or shown on the Drawings, the difference shall be referred to the General Contractor for coordinating electrical changes prior to installation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- C. Check line voltage and phase and ensure agreement with nameplate.
- D. All motor starters will be furnished under Division 26 - ELECTRICAL, unless otherwise specified.

END OF SECTION

SECTION 23 05 14
COMMON ELECTRICAL REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 APPLICABILITY

- A. This Section covers electrical work and equipment and applies to and forms a part of each Section of Division 23:

1.02 ELECTRICAL WORK

- A. All motor starters, starting switches, disconnects and variable frequency drives (VFD) will be furnished and installed under Division 26 - ELECTRICAL unless specified or as an integral part of the equipment being installed under Division 23.
- B. All electrical power wiring will be furnished and installed under Division 26 - ELECTRICAL unless specifically described as a part of the installation under Division 23.
- C. Electrical control wiring furnished and installed under Division 23 shall conform to the requirements of Division 26 - ELECTRICAL.
- D. Short Circuit Current Rating (SCCR):
 - 1. All mechanical equipment shall have SCCR withstand ratings equivalent to or greater than the available fault current (AFC) at the equipment. Under no circumstances may SCCR values be lower than the available fault current.
 - 2. Refer to ELECTRICAL EQUIPMENT SCHEDULES and MOTOR & EQUIPMENT SCHEDULES for minimum SCCR values of all electrical equipment including starters, disconnects, VFDs, controls, and motors furnished by this contractor.
 - 3. Where applicable, refer to results from Power Systems Studies in Division 26 for available fault current at equipment.

1.03 TESTING AGENCY CERTIFICATION

- A. All Electrical equipment furnished under this Section shall be labeled by a testing agency that is recognized by the State Board of Electricity.
- B. The equipment shall be constructed in accordance with the testing agency standard(s) that applies to the approved label.
- C. The testing agency label shall apply to the completed assembly. Equipment that utilizes labeled components but does not have a label for the completed assembly is not acceptable.
- D. The following testing agency labels are acceptable:
 - 1. Underwriter's Laboratories (UL):
 - a. UL508 - Industrial Control Equipment
 - 2. Others as approved by the State Board of Electricity.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION

SECTION 23 05 40
SUPPORTS AND ANCHORS - HVAC EQUIPMENT

PART 1 GENERAL

1.01 APPLICABILITY

- A. This Section covers supports and anchors and applies to and forms a part of each of the following Sections of Division 23.
 - 1. Section 23 23 00 - REFRIGERANT PIPING
 - 2. Section 23 70 00 - CENTRAL HVAC EQUIPMENT
 - 3. Section 23 80 00 - DECENTRALIZED HVAC EQUIPMENT
- B. Supports and anchors shall be in accordance with this and other applicable Sections of these Specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and Section 23 01 60 - HVAC PIPING PROCEDURES.
- C. Install pipe hangers and supports as Specified in this Section and/ or as indicated on the Drawings, conforming to Manufacturer's Standardization Society Standards SP58 and SP69.

PART 2 PRODUCTS

2.01 UPPER ATTACHMENTS

- A. Beam Clamps
 - 1. Beam clamps shall be used where piping is to be suspended from building steel. Clamp type shall be selected on the basis of load to be supported, and load configuration.
 - 2. C-Clamps shall have locknuts and cup point set screws, B-Line B351L, or B3036L. Top flange C-Clamps shall be used when attaching a hanger rod to the top flange of structural shapes, B-Line B3034 or B3033. Refer to manufacturers recommendations for setscrew torque. Retaining straps shall be used to maintain the clamps position on the beam where required.
 - 3. Center loaded beam clamps shall be used where specified. Steel clamps shall be B-Line B3050, or B3055. Malleable iron or forged steel beam clamps with cross bolt shall be B-Line B3054 or B3291-B3297 Series as required to fit beams.
- B. Concrete Inserts
 - 1. Cast in place spot concrete inserts shall be used where applicable; either steel or malleable iron body, B-Line B2500 or B3014. Spot inserts shall allow for lateral adjustment and have means for attachment to forms. Select inserts to suit threaded hanger rod sizes, B-Line N2500 or B3014N series.
 - 2. Continuous concrete inserts shall be used where applicable. Channels shall be 12 gauge, ASTM A1011 SS Grade 33 structural quality carbon steel, complete with styrofoam inserts and end caps with nail holes for attachment to forms. The continuous concrete insert shall have a load rating of 2,000 lbs./ft. in concrete,

B-Line B22I, 32I, or 52I. Select channel nuts suitable for strut and rod sizes.

2.02 ACCESSORIES

- A. Hanger Rods shall be threaded at both ends, or be continuously threaded rods of circular cross section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.
- B. Shields shall be 180 degree galvanized sheet metal, 12" minimum length, 18 gauge minimum thickness, designed to match outside diameter of the insulated pipe, B-Line B3151.
- C. Pipe protection saddles shall be formed from carbon steel, 1/8" minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12" shall have a center support rib.

2.03 FINISHES

- A. Indoor Finishes
 - 1. Hangers and clamps for support of bare copper piping shall be coated with copper colored epoxy paint, B-Line Dura-Copper(R). Additional PVC coating of the epoxy painted hanger shall be used where necessary.
 - 2. Hangers for other than bare copper pipe shall be zinc plated in accordance with ASTM B633 OR shall have an electro-deposited green epoxy finish, B-Line Dura-Green(R).
 - 3. Strut channels shall be pre-galvanized in accordance with ASTM A653 SS Grade 33 G90 OR have an electro-deposited green epoxy finish, B-Line Dura-Green(R).

PART 3 EXECUTION

3.01 STEEL SUPPORTS

- A. Provide all steel supports required for the mechanical equipment to be furnished under this Division, except where otherwise indicated.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 APPLICABILITY

- A. This Section covers pipe coding and equipment labeling and applies to and forms a part of each section of the Division 23 specifications under which piping and equipment are installed.
- B. Identification shall be in accordance with this and other applicable sections of these specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and Section 23 05 00 - COMMON WORK RESULTS FOR HVAC.

1.02 SUBMITTALS

- A. Submit and provide markers and tags for HVAC equipment.

PART 2 PRODUCTS

PART 3 EXECUTION

3.01 EQUIPMENT IDENTIFICATION

- A. Air handling units, fans and unit heaters shall be identified by service name and number either with permanent pre-manufactured 2" wide engraved plastic tags or by stenciling with 2" high black letters on contrasting color background.
- B. Identification locations shall be as directed by the Owner's representative.

END OF SECTION

SECTION 23 05 90
BASIC RESULTS FOR HVAC TESTING, ADJUSTING, AND BALANCING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work required under this Section of the Specifications consists of testing, adjusting and balancing the heating, ventilating and air conditioning (HVAC) systems as specified within this Section and as shown on the Drawings.
- B. Testing, adjusting and balancing work shall be done in accordance with the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS.
- C. The Mechanical Contractor shall retain the services of an independent certified Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) testing and balance firm specializing in balancing HVAC systems, to test, adjust and balance all of the air moving systems and hydronic heating and cooling systems installed under Division 23. The test and balance firm is subject to the approval of the Owner's Construction Representative. All work by this firm shall be done under the direct supervision of a qualified heating and ventilating engineer. If requested, the tests shall be conducted in the presence of an authorized representative of the Owner.
- D. Adjusting and balancing shall not begin until systems are complete, temporary filters and strainers are removed and permanent filters installed and piping systems are cleaned, flushed and chemically treated.
- E. In addition to demonstrating that the systems are capable of achieving design load point flows, the certified test and balance shall demonstrate that the automatic control systems respond properly to load variations.
- F. Test and balance firm shall include an extended warranty of 90 days, after completion of testing and balancing, during which time the Owner's Construction Representative may request a re-check, or re-setting of any outlet, supply air fan, return air fan or exhaust fan as listed in test report. The firm shall make any tests he may require during this period of time at no additional costs.

1.02 RELATED SECTIONS

- A. The following sections apply to and form a part of these Sections:
 - 1. Section 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

1.03 STANDARDS

- A. Adjusting and balancing shall be performed in accordance with the latest Standards of the National Environmental Balancing Bureau (NEBB), or approved equal, and as specified in the Contract Documents.

1.04 SUBMITTALS

- A. Comply with the provisions of Section 01 33 00 - SUBMITTALS PROCEDURES.

- B. The name of the certified test and balance firm, including the name and registration number of the certified test and balance supervisor, shall be submitted for approval within 30 days after project Contract award. The selected certified test and balance firm shall submit the following:
 - 1. Detailed Procedures.
 - 2. Agenda.
 - 3. Report Forms.
 - 4. National project performance guaranty/ Quality assurance program, or approved equal.
- C. An approved copy of each of the above shall be returned to the certified test and balance firm before adjusting and balancing is begun.
- D. Upon completion of the Work, the test and balance firm shall compile the test data and prepare and submit four (4) bound copies of the complete Test and Balance Report to the Mechanical Contractor whom shall forward three (3) copies to the Owner's Construction Representative for evaluation and approval.

1.05 INSTRUMENTATION

- A. The certified test and balance firm shall provide air system adjusting and balancing instrumentation such as pitot tubes, inclined gauge or U-tube manometers, magnehelic gauges, velometer, direct reading hood, tachometer or rpm counter, insertion thermometers, clamp-on ammeter for motor voltage and ampere readings and other instruments required to completely analyze and balance the HVAC systems. Instrumentation shall be accurately calibrated and checked before usage.

1.06 CONDITIONS

- A. The certified test and balance firm shall be accorded and provided the following:
 - 1. Cooperation of temperature control and electrical contractors.
 - 2. Reasonable time to complete the adjusting and balancing prior to the required completion date.
 - 3. Completely operable systems.
 - 4. The right to adjust the systems.
 - 5. Access to system components.
 - 6. Master keys if the building is occupied.
 - 7. Secure storage space for tools and instruments.

1.07 CONTRACTOR RESPONSIBILITIES

- A. The installing contractor shall be responsible for start-up and operation of systems during the adjusting and balancing process. Start-up shall include the following:
 - 1. All equipment operable in safe and normal condition.
 - 2. Temperature control systems installed complete and operable.
 - 3. Proper thermal overload protection in place for electrical equipment.
 - 4. For air systems:

- a. Final filters clean and in place.
 - b. Duct systems and air handling units clean of debris.
 - c. Correct fan rotation.
 - d. Fire, smoke, and volume dampers in place and open.
 - e. Access doors closed and duct end caps in place.
 - f. All outlets installed and connected.
5. For hydronic systems:
- a. Flushed, filled and vented.
 - b. All strainers cleaned and appropriate screens replaced.
 - c. Service and balancing valves open.

1.08 GENERAL ADJUSTING AND BALANCING PROCEDURES

- A. The certified test and balance firm shall coordinate with the Owner and the installing Contractor to perform the work in a manner to meet the project schedule.
- B. The certified adjusting and balancing firm shall leave all systems components in proper working order, including:
 - 1. Replace belt guards.
 - 2. Close access doors.
 - 3. Close doors to electrical switch boxes.
 - 4. Restore thermostats to specified setting.
- C. Recorded data shall represent a true, actually measured, or observed condition.
- D. Any abnormal conditions in the mechanical systems or conditions which prevent a proper adjusting and balancing process shall be reported to the Owner's Construction Representative.
- E. If for any reason, a system cannot be properly balanced, that fact shall be reported to the Engineer and Owner's Construction Representative.
- F. Should additional balancing devices be required, the certified test and balance firm shall so notify the installing contractor.
- G. If it is determined by the certified test and balance firm that drive changes are required, the installing Contractor shall obtain and install all necessary new components.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 APPLICABILITY

- A. This Section covers air systems testing, adjusting and balancing and applies to and forms a part of Division 23, Section 23 05 00 - COMMON WORK RESULTS FOR HVAC.
- B. Air systems testing, adjusting and balancing shall be in accordance with this Section of these Specifications and the requirements of Section 23 05 90 - BASIC RESULTS FOR HVAC TESTING, ADJUSTING, AND BALANCING.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 AIR SYSTEMS ADJUSTING AND BALANCING PROCEDURES

- A. Preparation for adjusting and balancing air systems:
 - 1. Adjusting and balancing shall not begin until the certified test and balance firm has verified that start-up procedures have been performed as required in the procedural standards of NEBB, or approved equal.
 - 2. Measure the amperes of all fan motors before adjusting and balancing is started and take proper steps to correct and report any overloads.
 - 3. Discontinue adjusting and balancing if any conditions are observed that are hazardous to the air system and report the conditions before proceeding further.
 - 4. Verify all outlets for compliance with design requirements and report any variations before starting the adjusting and balancing process.
- B. Supply and Return Fans:
 - 1. Set the RPM of the fans to provide design total CFM within acceptable limits as indicated in the NEBB, or approved equal, national standards and/ or required static pressure to operate the system.
 - 2. Fan speeds shall not exceed the maximum allowable as scheduled and as established by the fan manufacturer.
 - 3. The final setting of the fan RPM shall not result in overloading the fan motor in any mode of operation. Dampers shall be modulated, and the amperes of the supply, return and exhaust fan motors shall be measured to ensure that no motor overload can occur. The amperes shall be measured in the full cooling, heating and economizer modes to determine the maximum brake horsepower.
 - 4. After adjusting and balancing, the following values shall be recorded:

- a. Fan RPM.
- b. Motor voltage and amperes.
- c. Entering static pressure.
- d. Leaving static pressure.
- e. When applicable, final fan settings shall be based on rated wet cooling coil resistance.
- f. Final RPM of the supply and return fans, in systems having mixed air dampers, shall be set to provide the required minimum outside air CFM with the system in a logical non-modulating mode.
- g. When project conditions permit, static pressure shall be measured as follows:
 - 1) Static pressure leaving the fan shall be taken as far downstream from the fan as is practical, but shall be up- stream of any duct restrictions such as duct turns.
 - 2) No reading shall be taken directly at the fan outlet or through the flexible connection.
 - 3) Static pressure entering a single inlet fan shall be measured in the inlet duct up-stream of any flexible connection and down-stream of any duct restrictions.
 - 4) Pressure entering a double inlet fan shall be measured through the wall of the plenum which houses the fan.
- h. In all cases, the readings shall be taken so as to represent as true a value as possible. True value is actual measured static pressure.

C. Supply Air Outlets and Return/ Exhaust Air Inlets:

- 1. Quantities shall be measured according to NEBB, or approved equal, procedural standards. The systems shall be balanced so that the total supply air quantity into and out of each space shall be within ± 5 percent of the design airflows.
 - a. NOTE: In spaces where a negative pressure relationship must be maintained (screening/collection rooms, sludge thickening rooms, drywells, below grade pump rooms, and other locations as noted on the Drawings) supply air into the space shall be balanced to within -10 to +0 percent of

the design airflow and exhaust out of the space shall be balanced to within -0 to +10 percent of the design airflow.

2. Each outlet and inlet within the same space shall be adjusted to design quantities. Final quantities shall be obtained without generating noise levels in excess of the design parameters listed in the Construction Documents.
 3. The pattern for adjustable outlets shall be adjusted for proper distribution without drafts.
 4. If any outlet or inlet conditions are detected that will not allow proper balancing to be performed, the condition shall be reported to the Owner's Construction Representative and the Engineer.
 5. Under final balanced conditions, measure and record the static pressure entering and leaving each filter bank.
- D. Coils and Other Devices:
1. Under final balanced conditions, measure and record the static pressure entering and leaving each coil bank.
 2. The certified adjusting and balancing firm shall measure and record static pressures entering and leaving other devices not normally found in a system such as sound traps and heat recovery equipment.
- E. Automatic Temperature Control Dampers:
1. Verify temperature control dampers for proper shut-off when driven closed by the controller. Dampers shall also be verified to be in the same position as indicated by the controller. Corrections shall be referred to the installing Contractor for remedial action.
- F. Mixed Air Control:
1. Manual balancing dampers shall be restricted as necessary so the system supplies and returns essentially the same CFM in any mode of modulation.
 - a. Test mixed air plenums for possible stratification. If freeze-up or other serious problems are likely, the condition shall be reported at once.
 - b. Set the minimum outside air quantity to the required value. If this air flow quantity cannot be properly measured, the temperature method shall be used.

END OF SECTION

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SECTION 23 06 00
SCHEDULES FOR HVAC

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work required under this Section of the Specifications consists of performing all labor and furnishing all material, supplies and equipment including minor items obviously necessary for complete and functioning heating, ventilating and air conditioning (HVAC) systems as specified herein and as shown on the Drawings.
- B. Heating, ventilating and air conditioning work shall be in accordance with the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and Section 23 05 00 - COMMON WORK RESULTS FOR HVAC.
- C. The Work shall consist of the following:
 - 1. **Heating systems** including electric unit heaters.
 - 2. **Ventilation/exhaust systems** for the gallery level spaces including supply and exhaust fans, dampers, air intakes and outlets, louvers, and ductwork.
 - 3. **Air conditioning systems** for the pump rooms including wall mounted air conditioning units with D/X cooling coil, ductwork, registers and grilles.
 - 4. **Dehumidification systems** including self-contained refrigerant dehumidifiers.
 - 5. **Testing and balancing** all air systems.
 - 6. **Temperature control systems** for all new HVAC systems.

1.02 RELATED SECTIONS

- A. The following sections apply to and form a part of this Section:
 - 1. 23 90 00 HVAC CONTROLS AND INSTRUMENTATION

1.03 RELATED WORK DESCRIBED ELSEWHERE

- A. Insulation:
 - 1. Ductwork shall be insulated as specified in Section 23 07 00 - HVAC INSULATION.

1.04 SUBMITTALS

- A. Comply with the provisions of Section 01 33 00 - SUBMITTAL PROCEDURES.
- B. Within 30 calendar days of Contract Award, submit a complete list of materials, fixtures and equipment proposed to be furnished and installed under this Section.
- C. Submit shop drawings of the following:
 - 1. Dehumidifiers
 - 2. Control dampers
 - 3. Diffuser, register and grilles

4. Wall louvers
5. Sidewall exhaust fans
6. Wall mounted packaged air conditioners
7. In-line exhaust fans
8. Electric unit heaters
9. Insulation systems
10. Submit wiring diagrams for all applicable HVAC Equipment.

PART 2 PRODUCTS **NOT USED**

PART 3 EXECUTION

3.01 INSTRUCTIONS

- A. Upon completion and approval of the HVAC systems and installations, provide experienced personnel to instruct the Owner's designated operators on all details of operating and maintaining the HVAC systems and equipment.
- B. Provide a minimum of **8 labor hours** of instruction broken down into two (2) time periods within the first year of operation as requested by the Owner.

END OF SECTION

SECTION 23 07 00
HVAC INSULATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work required under this Section of the Specifications consists of performing labor and furnishing all materials for thermally insulating the HVAC work installed in each of the sections of Division 23.
- B. Insulation work shall be in accordance with the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS.

1.02 RELATED SECTIONS

- A. The following sections apply to and form a part of this Section:
 - 1. Section 23 07 13 - DUCTWORK INSULATION

1.03 STANDARDS

- A. All insulation work shall be performed by skilled, competent labor familiar with this type of work.
- B. All insulation shall present a neat, finished and skillful appearance.

PART 2 PRODUCTS

2.01 GENERAL

- A. Insulation shall be Owens-Corning, Schuller, Knauf, Armstrong, or approved equal.
- B. All insulating materials shall have fire and smoke hazard ratings as tested as a composite product by procedure ASTM E-84, NFPA 255 and UL 723. Material shall not exceed a flame spread rating of 25 and a smoke developed rating of 50, including adhesives.
- C. Insulation accessories, such as adhesives, mastics, cement, tapes and glass cloth shall have the same component rating as listed above.

PART 3 EXECUTION

3.01 INSULATION INSTALLATION

- A. Apply insulation over clean, dry surfaces and butt adjoining sections firmly together.
- B. Unless otherwise specified, insulated pipe supports shall be provided by the Mechanical Contractor and installed by the same during pipe support installation.

END OF SECTION

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SECTION 23 07 13
DUCTWORK INSULATION

PART 1 GENERAL

1.01 APPLICABILITY

- A. This Section of these Specifications covers ductwork thermal insulation and applies to and forms a part of Division 23, Section 23 07 00 - HVAC INSULATION.

PART 2 PRODUCTS

2.01 OUTSIDE AIR AND EXHAUST AIR DUCT INSULATION

- A. All outside air and exhaust air ducts within ten feet of the wall or roof penetration shall be externally insulated with rigid fiber glass board, 2" thick, 3 lb./ cu. ft. density having vapor barrier jacket of foil-scrim-kraft (FSK) with 2" tab.

2.02 AIR CONDITIONED DUCT INSULATION

- A. Ducts in Exposed Locations:
 - 1. All air conditioned air ducts in exposed locations shall be insulated with semi-rigid fiberglass board, 1" thick, 3 lb./cu. ft. density, having vapor barrier jacket of foil-scrim-kraft (FSK) with 2" tab.

PART 3 EXECUTION

3.01 DUCTWORK THERMAL INSULATION INSTALLATION

- A. Application:
 - 1. Insulation shall be applied in accordance with the manufacturer's published recommendations, unless otherwise specified.
- B. Outside, Combustion Air and Exhaust Air Duct Insulation:
 - 1. Apply insulation to all outside air intake louvers to the end of the duct sleeve.
 - a. All fresh air and combustion air ductwork from wall/roof penetration to connection at system or duct termination.
 - b. All unit heater vent piping where noted.
 - c. All exhaust air ductwork within 10 feet of wall or roof penetration.
 - 2. Secure insulation to metal with welded pins and mechanical fasteners on not over 18" centers leaving no voids at edges. Seal all butt joints with 3" wide joint sealing tape and seal all corner joints with 4" tape. Seal over pin clips with tape patches.
- C. Exposed Air Conditioned Ducts Insulation:
 - 1. Apply insulation to all air ducts exposed in non-air conditioned mechanical rooms and unfinished spaces.

2. Secure insulation to metal with welded pins and mechanical fasteners on not over 18" centers leaving no voids at edges. Seal all butt joints with 3" wide joint sealing tape and seal all corner joints with 4" tape. Seal over pin clips with tape patches.

END OF SECTION

SECTION 23 31 00
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 APPLICABILITY

- A. Ductwork shall be in accordance with this Section and other applicable sections of these Specifications and also follow the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and Section 23 05 00 - COMMON WORK RESULTS FOR HVAC.

1.02 GENERAL

- A. Furnish and install ductwork of type and material specified in this Section and as shown on the Drawings and as required to connect to all air handling equipment, air terminals and air handling system components.

1.03 COORDINATION

- A. Coordinate ductwork with equipment, piping and conduit to be provided by other trades.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 DUCT ARRANGEMENT

- A. Except where otherwise required by conditions of installation, install all ductwork symmetrical and/ or parallel with lines of the structure. Work duct carefully into place without springing or forcing.
- B. Drop and rise horizontal ducts only as necessary to clear piping, conduit, and floor and roof structures.

3.02 DUCTWORK

- A. Sheet Metal and Aluminum:
 - 1. Provide all sheet metal and aluminum work in conjunction with the Project air handling systems.
 - 2. Ductwork shall be run as high as possible in all rooms to maintain proper headroom. Wherever possible, ducts shall be run close to beams of floor slabs above and where two or more ducts cross each other, they must be arranged in such a manner as to maintain the greatest possible clearance underneath. Do not cover any electrical junction boxes. Coordinate with the other trades to avoid interference with pipe runs, etc.
 - 3. Inform the Architect/ Engineer before proceeding with any concealed ductwork that will require a ceiling to be lowered or shaft to be increased in size, etc. Should it be found impractical to install any duct of the exact sizes given, a duct of different shape but having the same resistance shall be installed.
 - 4. Provide offsets, elbows, and transformations in ductwork as required for a complete installation.

5. Construct rectangular ducts from zinc coated sheet steel in accordance with SMACNA duct construction standards for up to 2" w.c. static pressure including gauges and reinforcing.
6. Additional bracing where necessary shall be used and may be ordered by the Engineer wherever, in his opinion, such additional bracing is required.
7. All duct dimensions indicated on the Drawings are inside dimensions for the net free area.
8. All sides, including top and bottom of all ducts and plenums shall be constructed of sheet metal and no portion of the building construction, such as walls or slabs, shall be used as part of any duct or plenum, unless indicated for on the Drawings or otherwise specified.
9. Cross break sheet metal surfaces of rectangular ducts 18" through 60" in size.
10. Curved elbows shall have a centerline radius equal to 1.5 times the duct width.
11. Square turn elbows shall be fitted with turning vanes conforming to SMACNA standards. Vanes shall be double thickness, fastened to runners and adequately braced.
12. Duct branching shall be of the diverter type unless otherwise indicated.
13. Interconnect supply air ducts and supply air diffusers with flexible air ducts where indicated and to the extent allowed.
14. Tap-ins for flexible duct extensions to diffusers shall be radiused square-to-round with inlet openings which are 50 percent larger than branch duct size. Install a manual, adjustable, volume damper with position indicating and locking device in each branch tap-in.
15. Install air transfer ducts where indicated.
16. Dampers:
 - a. Fit dampers and splitters in ducts with an arm outside of the duct, set in the same direction and plane of the damper and positioned by the quadrant or regulator. Blades shall not exceed 6" in width for ducts 24" and smaller and 8" in width for larger ducts.
 - b. Damper rods shall be 5/16" and shall be fitted with brass bracing on one end for dampers 14" and under. For rods 15" long and over, fit the rods with brass bearings on each side of the duct.
 - c. Stiffen all dampers where necessary to prevent noise. Any damper causing any noise shall be replaced with a new one or additional stiffeners added so as to eliminate the noise.

17. Seal longitudinal and transverse joints in all supply air ducts with 3M Sealer 800, or approved equal, in accordance with SMACNA Class C requirements to produce a leakage rate of not more than 5 percent.
18. Outside air, exhaust air or relief air ducts entering or leaving the building and passing over finished ceilings shall be soldered absolutely watertight for a developed horizontal distance of 15 feet from the wall or roof opening.
19. Where ductwork penetrates walls or floors of mechanical rooms and rated walls where a fire or combination fire/ smoke damper is not present, "hand" stuff the space between opening and duct with glasswool and then fire stop edges with a minimum 1" depth 3M brand fire barrier caulk, UL Classified.
20. In exposed locations, trim the full perimeter of ducts penetrating walls not required to be fire dampered with 1-1/2" x 1-1/2" sheet metal angles finishing flush to the wall.
21. Whenever ducts penetrate the roof, outer walls or waterproofing of any kind, furnish and install all base flashing and all necessary counterflashing and caulking.
22. Provide watertight plenum beneath roof mounted exhaust fans and seal joints watertight with an approved sealer.
23. Coordinate with the General Contractor the location and size of all openings for ductwork that pass through walls, floors and partitions and provide duct sleeves as required.
24. Blank off all inactive areas of wall louvers with double wall sheet metal panels internally insulated with 2", 3 lb./ cu. ft. density rigid insulation. Seal all joints watertight.

3.03 DUCT HANGERS AND SUPPORTS

- A. Securely attach all ductwork to the building construction in a manner to be free from vibration and swaying under operating conditions.
- B. Hangers shall be galvanized strap hangers, bolted to the angle stiffeners or secured to the sides of the duct, adequately supported from the building structure with bolts, anchors, inserts and/ or clamps, as the condition requires.
- C. Stays on vertical lines of ducts shall consist of galvanized steel straps anchored to the building structure at such points as are necessary for properly supporting them and maintaining alignment.
- D. Trapeze all ductwork 36" and over in width using threaded rods and steel angles or Unistrut channels. Comply with SMACNA recommendations on loading, sizes and attachments. Hanger spacing shall not exceed 4'-0" centers.
- E. Where vertical ducts pass through floors, securely fasten supporting angles on at least two (2) sides of the ducts with rivets, screws, or bolts and support the assembly on the adjoining floor construction in an approved manner. Angles shall be 2" x 2" x 1/8" black iron primed with zinc chromate.

- F. Hanging one duct from another is prohibited.
- G. All fastenings and hardware for galvanized ductwork and sheet metal work shall be cadmium plated steel.
 - 1. All fastenings and hardware for stainless steel, aluminum and FRP ductwork shall be Type 316 stainless steel.
 - 2. Isolation of dissimilar metal components shall be provided with a material such as neoprene sheeting or equivalent.

3.04 FLEXIBLE CONNECTIONS

- A. Make duct connections to vibration isolated fan with fabric connections. Connections shall be not less than 6" wide. Allow 1" slack. Attach with bolted steel clamping bands and adhesive for airtight connection.

3.05 INSTALLATION OF DIFFUSERS, REGISTERS AND GRILLES

- A. Coordinate mounting locations of diffusers, registers and grilles with the work of other trades.
- B. Gasket and draw each device tightly to the surface to eliminate gaps and dirt streaking. Rigidly fasten ducts behind grilles, registers and diffusers.
- C. Install sheet metal retainers inside spiral duct air outlet collars for concealed screw fastening of linear slot diffusers.

3.06 ACCESS PANELS

- A. Fabricate and install duct access panels for access to duct mounted heating coils, D/X cooling coil, control dampers, backdraft dampers, fire dampers and control equipment. Panels shall be located and adequately sized for the purpose. Minimum panel size shall be 18" x 18" x 2" less than the duct size will permit.
- B. For ducts required to be insulated, access panels shall be double wall construction with 1" of insulation fill.
- C. Attach panels using zinc-plated cam latches, two (2) for sizes to 18" x 18" and four (4) for larger sizes. Seal edges with polyurethane foam.
- D. Coordinate with the General Contractor the locations of ceiling access panels, in inaccessible ceilings, to be adjacent to duct access panels to allow for damper servicing.

3.07 INSTALLATIONS SPECIFIED UNDER OTHER SECTIONS

- A. Masonry wall, floor and roof openings will be provided under the General Construction Work.
- B. Drains from outside air ducts will be installed under Division 22.
- C. Duct mounted smoke detectors will be furnished, installed and wired under Section 23 90 00, unless noted otherwise.

3.08 INSTALLATIONS OF EQUIPMENT PROVIDED UNDER OTHER SECTIONS

- A. Install air control dampers furnished under Section 23 33 00.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 APPLICABILITY

- A. Ductwork accessories shall be in accordance with this section of these specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and Section 23 05 00 - COMMON WORK RESULTS FOR HVAC.

1.02 GENERAL

- A. Furnish and install ductwork accessories where indicated on the Drawings and as specified in this Section.

PART 2 PRODUCTS

2.01 FLEXIBLE CONNECTIONS

- A. Flexible connections to vibration isolated fans shall be Ventglas, or equal, double neoprene coated, fire retardant fabric.

2.02 CONTROL DAMPERS

- A. Control dampers shall be Ruskin CD50, Cesco, Arrow, Greenheck, or approved equal, frame mounted with rectangular opposed blades. Damper frame shall be 5" wide, extruded aluminum hat-shaped channel. Blades shall be extruded aluminum with maximum 6" spacing and maximum 48" in length. Linkage shall have brackets riveted to the blades with aluminum rod locked to the pivots. Bearings shall be Oilite Bronze. Axles shall be extended for motor actuator attachment. Dampers shall be suitable for velocities up to 2,000 FPM.
 - 1. Dampers shall be low leakage construction with polyurethane blade and jamb seals.
 - 2. Dampers shall be louver size or duct size as applicable or sized as scheduled on the Drawings.

PART 3 EXECUTION

END OF SECTION

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SECTION 23 34 16
CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.01 APPLICABILITY

- A. Centrifugal fans shall be in accordance with this and other applicable sections of these specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and 23 05 00 - COMMON WORK RESULTS FOR HVAC.

1.02 GENERAL REQUIREMENTS

- A. Furnish and install centrifugal fans where indicated on the Drawings and as specified in this Section.

PART 2 PRODUCTS

2.01 IN-LINE CENTRIFUGAL FANS

- A. In-line centrifugal fans shall be Greenheck, Twin City Fan, or Loren Cook, AMCA certified. Fully cased, with fan motor, direct or belt drive as Scheduled on the Drawings and mounting or hanging isolators matched to the respective fan. All exposed parts of the unit shall be finished with a baked enamel paint, color as selected by the Owner. All internal framework shall receive a prime coat of paint. Fans shall bear the AMCA Certified Rating Performance Seal.
 - 1. Casing: Heavy gauge galvanized reinforced steel, with an isolated, accessible, hinged motor enclosed.
 - 2. Fan: Spun venturi throat overlapped by a backward curved centrifugal wheel with spun cone. Statically and dynamically balanced. Fan shaft shall be ground, polished and mounted in heavy duty sealed pillow block bearings.
 - 3. Direct Drive Fan: Provide variable speed controller to control fan capacity from 50-100 percent. Compatible motor shall be permanent split capacitor and/or shaded pole type.
 - 4. Furnish low leak motorized control damper or backdraft dampers as scheduled.
 - 5. Direct drive motors to be DC electronic communication type (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Motors are permanently lubricated, heavy duty ball bearing type. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
 - 6. Connections: Provide flexible connections to both the inlet and discharge sides of the fan. Also provide mounting structure per manufacturers recommendations. Mount using neoprene fasteners for vibration control.

- B. In-line fan performance capacity and characteristics shall be as Scheduled on the Drawings.

PART 3 EXECUTION

3.01 IN-LINE FAN INSTALLATION

- A. Install equipment in accordance with the manufacturer's recommendations.
 - 1. Hang the centrifugal fans from structure with vibration isolators. Coordinate mounting locations level and align each unit.

3.02 INSTALLATIONS SPECIFIED UNDER OTHER SECTIONS

- A. Disconnects for the fan units will be provided under Division 26.
- B. Power wiring to each fan unit will be provided under Division 26.

END OF SECTION

SECTION 23 34 23
HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 APPLICABILITY

- A. Power ventilators shall be in accordance with this and other applicable sections of these specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and 23 05 00 - COMMON WORK RESULTS FOR HVAC.

1.02 GENERAL REQUIREMENTS

- A. Furnish and install power ventilators where indicated on the Drawings and as specified in this Section.

PART 2 PRODUCTS

2.01 SIDEWALL EXHAUSTER

- A. Sidewall exhausters shall be Greenheck, Twin City Fan or Loren Cook, centrifugal exhausters, AMCA certified.
 - 1. Construction of wind band shall be heavy gauge aluminum with rolled bead for added strength. Unit construction shall allow for removal of the entire power assembly and wheel for servicing and cleaning by removing fasteners.
 - 2. Fan wheel shall be backward curved centrifugal type with inlet venturi, statically and dynamically balanced. Blades, fins, inlet cone and backplate shall be fabricated from aluminum and securely joined together.
 - 3. Motor and fan wheel shall be mounted on vibration isolators.
 - 4. Motor shall be isolated from the exhaust air stream and readily accessible for maintenance. Design shall provide containment free air to be taken into the motor compartment for air cooling motor.
 - 5. Variable pitch V-belt or direct drive as scheduled.
 - a. Direct drive motors to be DC electronic communication type (ECM) specifically designed for fan applications. AC induction type motors are not acceptable. Motors are permanently lubricated, heavy duty ball bearing type. Internal motor circuitry to convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20 percent of full speed. Speed shall be controlled by either a potentiometer dial mounted at the motor or by a 0-10 VDC signal.
 - 6. Furnish low leak motorized control damper or backdraft dampers as scheduled.
 - 7. Furnish solid speed controller for direct drive units as scheduled and mount on fan housing under hood.

- B. Sidewall exhauster performance capacities and characteristics shall be as scheduled on the Drawings.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

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

END OF SECTION

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 APPLICABILITY

- A. Air terminal units shall be in accordance with this Section of these Specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and Section 23 05 00 - COMMON WORK RESULTS FOR HVAC.

1.02 GENERAL REQUIREMENTS

- A. Furnish and install air terminal units where indicated on the Drawings and as specified in this Section.

PART 2 PRODUCTS

2.01 DIFFUSERS, REGISTERS AND GRILLES

- A. Diffusers, registers and grilles shall be Price, or approved equal, Titus, Nailor, or Price as scheduled within this section.
- B. All registers shall be provided with opposed blade volume control dampers, key operated.
- C. Where indicated on the Drawings, individually adjustable deflecting vanes shall be provided to control air volume and deflect the supply air for even distribution through supply grille, register or diffuser.
- D. Schedule:
 - 1. S1 - Supply registers - for sidewall and exposed duct installations: Model 620DAL, register with 1-1/4" margin, double deflection, adjustable, vertical face and horizontal rear vanes, 3/4" vane spacing, opposed blade dampers, aluminum construction
- E. Finishes:
 - 1. Ceiling diffusers, registers and grilles shall have off-white baked enamel finish.
 - 2. Other grilles and registers shall have prime coat finish.

PART 3 EXECUTION

END OF SECTION

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SECTION 23 37 00
AIR OUTLET AND INLETS

PART 1 GENERAL

1.01 APPLICABILITY

- A. Air outlets and inlets shall be in accordance with this Section of these Specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and Section 23 05 00 - COMMON WORK RESULTS FOR HVAC.

1.02 GENERAL REQUIREMENTS

- A. Furnish and install air outlets and inlets where indicated on the Drawings and as specified in this Section.

PART 2 PRODUCTS

2.01 WALL LOUVERS (ALUMINUM)

- A. Wall louvers shall be Ruskin ELF6375DX, Greenheck, Cesco, Arrow or approved equal, each with formed drainable 38° blades, fixed to a 6" channel frame , extruded aluminum, 0.081" thick construction, baked enamel finish and internally mounted 1/2" expanded aluminum bird screen. Color as selected by Architect.
- B. Louver sizes shall be as indicated on the Drawings.

PART 3 EXECUTION

3.01 WALL LOUVER INSTALLATIONS

- A. Install wall louvers for air intake and exhaust. Coordinate louver openings to be rough-in by General Contractor. Securely attach louvers with cadmium plated fasteners. Caulk the entire perimeter of each louver.

END OF SECTION

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SECTION 23 81 19
SELF-CONTAINED AIR-CONDITIONERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted air conditioning units.
- B. Controls.

1.02 SUBMITTALS

- A. Product Data: Provide drawings indicating dimensions, rough-in connections, and electrical characteristics and connection requirements.
- B. Manufacturer's Instructions: Include assembly instructions, support details, connection requirements, and start-up instructions.
- C. Sustainable Design Documentation: Submit manufacturer's product data on refrigerant used, showing compliance with specified requirements.
- D. Operation and Maintenance Data: Provide maintenance data, parts lists, controls, and accessories. Include trouble-shooting guide.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- C. Comply with ANSI/ASHRAE/IES 90.1-2019 and ANSI/AHRI Standard 390-2021 for SPVU units.
- D. Units shall be ETL listed and comply with ANSI/UL 60335-1 and 60335-2-40 standards.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect finished cabinets from physical damage by leaving factory packing cases in place before installation and providing temporary covers after installation.

1.05 WARRANTY

- A. Provide a five year warranty to include coverage for refrigeration compressors and parts.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Bard Manufacturing Company

- B. Marvair
- C. Eubank
- D. Approved Equal

2.02 AIR CONDITIONING UNITS

- A. Description: Packaged, self-contained, wall mounted air conditioning units, electric refrigeration system, electric heating, outside air louvers, built-in temperature controls; fully charged with refrigerant and filled with oil.
- B. Refrigerant: R-454B A2L Refrigerant. Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) no greater than that allowed by federal code.
- C. Electrical Characteristics:
 - 1. 460 volts, single phase, 60 Hz.
- D. Energy Efficiency:
 - 1. Full flow economizer
 - 2. Cooling Capacity: Greater than 120,000 Btu/h:
 - a. Energy Efficiency Ratio: 10.0, minimum.

2.03 CABINET

- A. Cabinet: Wall mounted of 16 gauge zinc coated steel with baked enamel finish, removable front panel, color as selected by owner.

2.04 CHASSIS

- A. Refrigeration System:
 - 1. Direct expansion cooling coil.
 - 2. Scroll compressor with internal spring isolation, external isolation, permanent split capacitor motor and overload protection.
 - 3. Condenser coil and fan.
 - 4. Minimum of 3 stages of cooling.
 - 5. 2" MERV 8 filter
- B. Air System: EC indoor industrial fan assembly.

2.05 CONTROLS

- A. PGDX Single Unit Controller.

2.06 SUPPLY AND RETURN GRILLES

- A. Provide with manufacturer's recommended return grille.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Coordinate with Structural Engineer for unit support stand.

END OF SECTION

SECTION 23 82 10
DEHUMIDIFIERS

PART 1 GENERAL

1.01 APPLICABILITY

- A. Dehumidifiers shall be in accordance with this section of these specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS and Section 23 05 00 - COMMON WORK RESULTS FOR HVAC.

1.02 GENERAL

- A. Furnish and install self-contained refrigerant type dehumidifiers where indicated on the Drawings and as specified in this Section.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Refrigerant dehumidifier unit shall be as manufactured by Therma-Stor (Quest), or acceptable substitute, with sizes and capacities as scheduled on the Drawing.

2.02 REFRIGERANT DEHUMIDIFIER

- A. Provide refrigerant dehumidifiers with filters, control panel, and all necessary controls for proper operation of the system. The dehumidifier unit shall be arranged to provide continuous dehumidification with constant outlet temperature and humidity for a given inlet condition.
 - 1. The high efficiency dehumidifier utilizes refrigeration to cool the incoming air stream below its dew point as it passes through the evaporator coil. This cooling resulting in the removal of moisture and reduction in temperature. The cooled and dried air is used to pre-cool the incoming air stream resulting in up to 200 percent increase in overall efficiency. After the pre-cooling stage the processed air is reheated by passing through the condenser coil. The latent heat removed by the evaporator coil is returned to the air stream at this stage as sensible heat, resulting in an overall temperature increase from the incoming air.
 - 2. The unit is controlled by a de-humidistat with settings from 20 to 80 percent relative humidity and a positive "on" and "off" setting.
 - 3. The unit contains a blower switch that permits continuous blower operation independent of dehumidification.
 - 4. The unit is portable and provided with four casters.
 - 5. The unit contains an internal condensate pump capable of lifting condensate 12 feet, and 20 feet of condensate hose.
 - 6. The wiring of the unit is through a factory installed six foot power cord, 115 volt with ground.
- B. The unit shall be factory tested and ready for use except for power connections.

2.03

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

- A. Install dehumidifier per manufacturer's installation instructions, where indicated on the Drawings.
- B. Provide electrical connection as indicated.
- C. Pipe condensate drain from unit drain pan to nearest floor drain.

3.03 SCHEDULES

- A. Refer to Equipment Schedules on the Drawings for capacities and characteristics.

END OF SECTION

SECTION 23 90 00
HVAC CONTROLS

PART 1 GENERAL

1.01 APPLICABILITY

- A. This Section covers HVAC control systems and components and applies to and forms a part of Division 23, Section 23 06 00 - SCHEDULES FOR HVAC.

1.02 SCOPE OF WORK

- A. The Work required under this Section of the Specifications consists of performing all design engineering, labor and furnishing all control equipment including peripherals, wiring, conduit, interface, programming and minor items obviously necessary to control, monitor and alarm the functions and systems specified herein.
- B. Control work shall be in accordance with the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS.
- C. The Work shall consist of controls for the following:
 - 1. Ventilation Systems.
 - 2. Exhaust Fans.
 - 3. Air conditioning units.
 - 4. Heaters.

1.03 RELATED SECTIONS

- A. Section 23 98 00 - HVAC INSTRUMENTATION
- B. Section 23 98 50 - HVAC SEQUENCE OF OPERATIONS

1.04 RELATED WORK DESCRIBED ELSEWHERE

- A. After completion of the mechanical installation, the Controls Contractor shall assist the Mechanical Contractor in starting the mechanical equipment and systems and shall test, adjust, and demonstrate the environmental controls as described in the following Sections:
 - 1. Section 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

1.05 COORDINATION

- A. Coordinate control requirements with the interfacing work provided under other Sections of these Specifications and Division 26.
- B. Coordinate locations of all temperature and pressure sensors, thermostats and immersion wells.

1.06 SUBMITTALS

- A. Comply with the provisions of Section 01 33 00 - SUBMITTAL PROCEDURES.
- B. Submit shop drawing of the controls including complete information on the components, written description of the system monitoring and control

functions and capabilities, schematic flow diagrams, power, signal and control wiring diagrams, details of control panel faces, damper schedule, valve schedule. DDC System Hardware including wiring diagrams, schematic floor plans and schematic control diagrams. Control System Software including schematic diagrams, written descriptions and points list.

- C. Submit four (4) bound copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the temperature controls supplied.

1.07 WARRANTY

- A. All control devices and installation shall be warranted to be free from defects in workmanship and material for a period of one year from the date of project acceptance by the Owner. Any equipment, software, or labor found to be defective during this period shall be repaired or replaced without expense to the Owner.

1.08 MAINTENANCE SERVICE

- A. Provide service and maintenance of control system for one year from the Date of Final Completion.
- B. Provide complete service of controls systems, including call backs. Make a minimum of 3 complete normal inspections of approximately 4 hours duration at the facility in addition to normal service calls to inspect, calibrate and adjust controls and submit written reports.

1.09 MECHANICAL SYSTEMS START-UP AND INSTRUCTION

- A. The various mechanical systems shall be put into operation under the direct supervision of the temperature control contractor's service engineer and his services shall be paid for by the Mechanical Contractor. The service engineer shall check the calibration and control settings and shall verify the proper operation of all safety and operating controls both in the spring and in the fall at the beginning of the heating season. He shall instruct the Owner's designated Representative on the operation of the various mechanical systems and the control systems.
- B. Furnish, without additional cost to the Owner, the services of competent instructors, who shall fully instruct the Owner's designated representatives in the care, adjustment and operation of the mechanical systems.
- C. The total number of man-hours of instruction furnished shall be twelve (12). Hours of instruction shall be divided up into a minimum of three (3) instruction periods with 33 percent of time used for initial instructions and 33 percent of time used for follow-up instructions, a minimum of four (4) weeks after the initial instructions and 33 percent of time used at the 11 month time period.

1.10 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION NOT USED

END OF SECTION

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SECTION 23 98 00
HVAC INSTRUMENTATION

PART 1 **GENERAL**

1.01 APPLICABILITY

- A. This Section covers instrumentation and applies to and forms a part of Division 23, Section 23 90 00 - HVAC CONTROLS.
- B. Instrumentation shall be in accordance with this section of these specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS.

1.02 GENERAL

- A. Furnish and install instrumentation of type and characteristics specified in this Section and as required for sequences of control specified in Section 23 98 50 - HVAC SEQUENCE OF OPERATIONS.

PART 2 **PRODUCTS**

2.01 DAMPERS

- A. Furnish operators for motor operated dampers not furnished under other sections.
 - 1. Refer to Equipment Schedules for additional information on motor operated dampers.
 - 2. Refer to Section 23 33 00 for additional information on operated dampers.
 - 3. Provide linkages and actuators for all control dampers.

2.02 ELECTRIC CONTROLS

- A. Actuators:
 - 1. Belimo, proportional, modulating or two position damper actuator, electronic, direct coupled type, U.L. Listed. Spring return or non-spring return as specified or required by the sequence of control. Non-spring return actuators shall have reversing switch and gear disengagement button on cover. All actuators shall be electronically protected from overload at all angles of rotation. Modulating actuators shall have a brushless DC motor. Run time shall be constant and independent of torque and angular rotation between 35° and 95°. Actuator shall be controlled with a 2 - 10 VDC or 4 - 20 mA input signal from an electric analog controller or On/Off signals.

2.03 ELECTRICAL WIRING

- A. Wiring in conjunction with the temperature control system shall be done by Division 23 unless specifically stated otherwise
- B. Refer to Division 26 for materials and methods.
- C. Provide conduit and electrical wiring in accordance with Division 26 and in accordance with conduit types and electrical classifications as shown on

the Electrical Drawings. HVAC control circuitry shall be installed within its own conduit systems provided under this section. Do not install HVAC control circuitry within conduit systems that are shown on the Electrical Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 62" above the floor.
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- B. Install guards on thermostats in the following locations:
 - 1. Where indicated.
- C. Install automatic dampers according to Section 23 33 00 - AIR DUCT ACCESSORIES .
- D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- E. Install labels and nameplates to identify control components according to Division 23 Section 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT.
- F. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

3.02 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 26 Section "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.

END OF SECTION

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SECTION 23 98 50
HVAC SEQUENCE OF OPERATIONS

PART 1 GENERAL

1.01 APPLICABILITY

- A. This Section covers the sequence of controls and applies to and forms a part of Division 23, Section 23 90 00 - HVAC CONTROLS.
- B. The sequence of controls shall be in accordance with this section of these specifications and the requirements of Section 23 01 20 - HVAC GENERAL PROVISIONS.

1.02 GENERAL

- A. Furnish and install controls which will affect the operational sequences described for the heating, ventilating and air conditioning systems installed under Division 23.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.01 EQUIPMENT

- A. The thermostats located on cold walls shall be mounted on an insulated backplate and piping penetrations through the wall are to be sealed airtight.
- B. All thermostats and controllers shall be labeled as to function and temperature setpoint.

3.02 SEQUENCE OF OPERATIONS

- A. PUMP ROOM AIR CONDITIONING SYSTEM:

Wall mounted air conditioner ACU-1:

Unit schedule and setpoint control:

- a. Zone cooling setpoint shall be 80°F (adj.)
- b. The unit shall operate at all times.

Temperature and state control:

- a. The cooling demand shall modulate between 0-100% to maintain the zone temperature at cooling setpoint.
 - 1) When economizer is active, as the cooling demand increases from 0-100%, the discharge temperature setpoint shall decrease from the zone cooling setpoint (80°F) to a minimum of 45°F (adj.)

- 2) When economizer is disabled or at maximum, the cooling demand shall be used to stage cooling coil as described in the cooling control paragraph.

Supply fan control - Constant Volume

- a. Fan shall be commanded on at all times.
- b. Fan speed shall linearly reset from minimum to maximum as cooling demand increases from 50% to 100%. Speed transitions shall happen gradually, limited to 5% change every 1-minute.

Outside air damper control

- a. Economizer state decision:
 - 1) Enabled when the outside air temperature is less than 50°F outside air temperature is more than 5°F less than return air temperature.
- b. When economizer control is enabled, the outside air damper shall be modulated between the calculated minimum position and 100% in order to maintain the calculated discharge air temperature setpoint. Economizer shall be fully utilized before enabling any mechanical cooling and shall be held at 100% when mechanical cooling is active.
- c. When economizer control is disabled, the outside air damper shall be fully closed.

Cooling Control - Staged DX

- a. The DX cooling shall stage across the full cooling demand signal range.
 - 1) Stages shall enable as cooling demand signal increases, and disable once signal falls back below the differential. Differential shall be equal to the signal range divided by the number of stages.
 - 2) Individual stages shall have minimum on-time and minimum-off time of 10 minutes (adj.). There shall be a 5-minute (adj.) inter-stage delay.

The controller will be provided with the unit and installed by the T.C. contractor. All interlocks and control wiring to be furnished and installed by the T.C. contractor. Coordinate control wiring

termination point with Division 26. All control wiring to be routed in a dedicated conduit in accordance to the Division 26 standards. All power wiring to be by Division 26.

B. LOWER LEVEL VENTILATION SYSTEM:

Exhaust fan EF-1, supply fan SF-1 and motorized dampers, MD-1 and MD-2:

Motorized dampers shall fully open and EF-1 and SF-1 shall operate when lights in space are switched on.

All interlocks, relays, damper actuators and control wiring to be provided by the T.C. Contractor. Coordinate control wiring termination point with Division 26. All control wiring to be routed in a dedicated conduit in accordance to the Division 26 standards. All power wiring to be provided by Division 26.

C. BUILDING HEATING SYSTEM:

Electric unit heaters EUH-1,2,3,4:

Each electric unit heater is furnished with a unit mounted thermostat which will cycle heater as required to maintain a space temperature of 65°F (adj.).

All interlocks and control wiring to be furnished and installed by the T.C. Contractor. Coordinate control wiring termination point with Division 26. All control wiring to be routed in a dedicated conduit in accordance to the Division 26 standards. All power wiring to be furnished and installed by Division 26.

PROVIDE ALL THERMOSTATS WITH A ENGRAVED PERMANENT PLASTIC LABEL MOUNTED ON THE WALL AT THE THERMOSTAT AND LABELED "HEATING OR COOLING", TEMPERATURE SET POINT (IF REQUIRED) AND EQUIPMENT SERVED.

END OF SECTION

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DIVISION 26 ELECTRICAL

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SECTION 26 00 00
ELECTRICAL GENERAL CONDITIONS

PART 1 GENERAL

1.01 SUMMARY

- A. The General Conditions of these Specifications shall form a part and be included under this section of the Specifications. The Contractor shall provide all supervision, labor, material, equipment, machinery and any other items necessary to complete the electrical systems. All items of equipment are specified in the singular; however, the Contractor shall provide and install the number of items of equipment as indicated in the Drawings, and as required for complete systems.

1.02 WORK UNDER THIS DIVISION

- A. It shall be noted that this Section of the Specifications includes:
 - 1. GENERAL
 - 2. ELECTRICAL REQUIREMENTS

1.03 CODES, RULES, PERMITS, FEES

- A. The Contractor shall give all necessary notices, obtain all permits and pay all government and state sales taxes, fees, and other costs, including utility connections or extensions, in connection with his work; file all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Engineer before request for acceptance and final payment of the work.
- B. All materials furnished and all work installed shall comply with the currently adopted Edition of the National Electrical Code, with the requirements of local utility companies, and with the requirements of all governmental departments having jurisdiction.
- C. All material and equipment for the electrical portion of the system shall bear the approval label, or shall be listed by Underwriter's Laboratories, Limited Liability company or another Nationally Recognized Testing Laboratory (NRTL) approved by OSHA and the local electrical inspector.

1.04 INTENT

- A. It is the intention of these specifications and drawings to call for finished work, tested, and ready for operation. Wherever the word "provide" is used, it shall mean "furnish and install complete and ready for use."

1.05 SURVEYS AND MEASUREMENTS

- A. The Contractor shall base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check correctness of same as related to the work.
- B. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, they shall notify the Engineer, through the General Contractor, and shall not proceed with the work until they have received instructions from the Engineer.

1.06 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of systems and work included in the contract. The engineering drawings and details shall be examined for exact locations of fixtures and equipment. Where they are not definitely located, this information shall be obtained from the Engineer.
- B. The Contractor shall follow drawings in laying out work, and check drawings of other trades to verify spaces in which work will be installed.

1.07 "OR EQUAL"

- A. Wherever the words "or equal" or "equal to" or "equivalent" are used in connection with any specified material, it is to be understood that such words mean any material or work of any kind claimed to be an equal in quality to the work or material specified but does not require prior written approval by the Engineer.
- B. Wherever the words "approved equal" or "prior approved equivalent" are used in connection with any specified material, it is to be understood that such words mean any material or work of any kind claimed to be an equal in quality to the work or material specified and shall be so approved in writing by the Engineer.
- C. It is further understood that no material or work shall be presented to the Engineer as work or material equal to that specified with the full understanding on the part of the manufacturers and agents for the so called "equal" material, and the full understanding on the part of the Contractor, that the Engineer is to use his own judgment in the matter, that his decision is final, and that in the event of an adverse condition, no claim of any sort shall be made against the Owner or Engineer.

1.08 SHOP DRAWINGS

- A. The Contractor shall submit for approval, detailed shop drawings of all equipment and all material required to complete the project, and no material or equipment may be delivered to the job site or installed until the Contractor has in his

possession the approved shop drawings for the material or equipment. The shop drawings shall be completed as described by Specification Section 01 33 00 - Submittal Procedures.

1.09 EQUIPMENT DEVIATIONS

- A. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, or structural layout, all such redesign and all new drawings and detailing required therefore shall be prepared by the Contractor at his own expense and approved by the Engineer.
- B. Where such approved deviation requires a different quantity and arrangement of wiring, conduit, and equipment from that specified or indicated on the drawings, the Contractor shall furnish and install any such controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system at no additional cost to the Owner.

1.10 COOPERATION WITH OTHER TRADES

- A. This Contractor shall give full cooperation to other trades and shall furnish in writing to the Contractor, with copies to the Engineer, any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- B. Where the work of the Contractor will be installed in close proximity to, or will interfere with the work of other trades, they shall assist in working out space conditions to make a satisfactory adjustment. If the Contractor installs their work before coordinating with other trades or so as to cause any interference with work of other trades, they shall make the necessary changes in his work to correct the condition without extra charge.
- C. The Contractor shall furnish to other trades, as required, all necessary shop details for the proper installation of work and for the purpose of coordinating adjacent work.
- D. Refer to other Divisions of the Specifications for equipment furnished by others and work required thereof by the Contractor.

1.11 PROTECTION

- A. The Contractor shall protect all work and material from damage by their work or workmen and shall be liable for all damage thus caused.
- B. The Contractor shall be responsible for work and equipment until finally inspected, tested, and accepted; contractor shall protect work against theft, injury or damage; and shall carefully store material and equipment received on site, which is not immediately installed. Contractor shall close open ends of work with

temporary covers or plugs during storage and construction to prevent entry of obstructing material.

1.12 SCAFFOLDING, RIGGING, HOISTING

- A. The Contractor shall furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any electrical equipment and electrical apparatus furnished. Remove scaffolding, rigging, hoisting, and services from premises when no longer required.

1.13 MATERIAL AND WORKMANSHIP

- A. All materials and apparatus required for the work, except as specifically specified otherwise, shall be new of first-class quality, and shall be furnished, delivered, erected, connected, and finished in every detail, and shall be so selected and arranged as to fit properly into the available spaces. Where no specific kind or quality of material is given, a first-class standard article as approved by the Engineer shall be furnished.
- B. The Contractor shall furnish the services of an experienced superintendent who shall be constantly in charge of the installation or work, together with all skilled workmen, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate, and test each system. The job superintendent shall be a Master Electrician licensed in the State where the work is being performed.
- C. Unless otherwise specifically indicated on the plans or specifications, all equipment and materials shall be installed with the approval of the Engineer in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

1.14 APPLICABLE STANDARDS

- A. Provide work in accordance with applicable rules, codes, ordinances and regulations of local, state, federal governments, and other authorities having lawful jurisdiction. Conform to the latest editions and supplements of codes, standards, and recommended practices.
- B. Drawings and specifications indicate minimum construction standards. Should any work indicated be substandard to any ordinances, lower codes, rules or regulations bearing on work, the Contractor shall promptly notify the Engineer in writing, through the General Contractor, of any necessary changes to be adjusted. However, if Contractor provides any work knowing it to be contrary to any ordinances, laws, rules and regulations, they shall thereby have assumed full responsibility and bear all costs involved for correction and compliance. In any instance where the specifications call for materials for construction of a better quality or larger size than required by codes, provisions of these specifications

shall take precedence. Codes shall govern in case of direct conflict between codes, plans and specifications.

1. Safety Codes:
 - a. National Electrical Safety Code Handbook H30-National Bureau of Standards
 - b. Occupational Safety and Health Standard (OSHA) - Department of Labor
2. National Fire Codes:
 - a. NFPA 70 - NATIONAL ELECTRICAL CODE, current adopted Edition.
3. Underwriters Laboratories, inc.:
 - a. UL 508A Standard
 - b. All applicable UL standards as referenced in other section.
4. Third Party Certification:
 - a. All equipment not bearing a UL listing shall be provided with a third-party certification stamped by a registered Professional Engineer licensed in the state of which the work is being performed.
5. Utah State Electrical Board:
 - a. Laws, Rules, Wiring Standards, and all applicable local state standards.

1.15 TESTS AND OPERATION RECORDS

- A. General: Test all equipment installed under this specification and demonstrate its proper operation to the Engineer. No equipment shall be tested or operated for any other purpose, such as checking motor rotation, until it has been fully lubricated in accordance with manufacturer's instructions and, if it is a centrifugal pump, until it has been connected to piping systems and supplied with sufficient water so that it will not run dry.
 1. Any defects in workmanship, material, equipment or any grounds or short circuits shall be corrected by the Contractor before final acceptance.
 2. Submit a searchable electronic copy or a minimum of three (3) copies of data noted below to the Engineer prior to final inspection.
 3. Maintain a marked set of drawings to record all deviations made from routes, locations, circuiting, etc. shown on contract drawings. Prior to final inspection submit one new set of project drawings with deviations and changes clearly indicated.
- B. Testing: The entire electrical system shall be tested by Contractor in presence of the Engineer. Every local switch, panelboard, service breaker, safety switch, and circuit breaker shall be operated under load conditions. Every fixture and equipment tested and operated. Tests shall include any tests specified in any part of this section.

1. The Contractor shall measure resistance of electrical system with a "Megger" from busses of main switch to ground with main breaker open, and bonding jumper between neutral and ground temporarily removed. Values are to be determined with all panelboards, motor controls and switch circuits open. If any value measured is less than 100,000 ohms, each feeder shall be measured and must exceed those set forth in Article 110 of National Electrical Code, before they shall be accepted. Typewritten test results shall be furnished to the Engineer.

C. Recording and Distribution

1. Record nameplate horsepower, amperes, volts, phase, efficiency, service factor and other necessary data on motors, and other electrical equipment furnished and/or connected under this contract.
2. Record motor starter catalog number, size and rating and/or catalog number of thermal overload units installed in all motor starters furnished and/or connected under this contract. See motor starter specifications for instructions for proper sizing of thermal overload units.
3. Record ampere per phase at normal or near normal loading of each item of equipment furnished and/or connected.
4. Record voltage and ampere per phase readings taken at service entrance equipment after completion of project with operation at normal electrical load.
5. Record all VFD settings, solid-state motor controller settings, electronic overload relay settings, relay settings, device settings, and related electronic equipment settings.
6. Record all instrumentation and device calibration settings.
7. Distribute copies of all recorded information to the Engineer along the project O&M manuals.

1.16 DEMONSTRATION OF COMPLETED ELECTRICAL SYSTEMS

- A. General: Upon completion of entire electrical systems, Contractor shall demonstrate to Engineer's satisfaction that all installed electrical systems are in perfect operating condition, that they perform all power and control functions intended and that they are installed in strict accordance with project drawings and specifications.
- B. Materials: Contractor shall provide all necessary testing equipment, tools, materials, dummy loads, etc., required to properly demonstrate performance.

1.17 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Provide O/M manuals per Specification Section 01 35 16.01 - LEED 2009 Material Cost Summary Form

PART 2 ELECTRICAL REQUIREMENTS

2.01 BASIC MATERIALS

- A. General: Material and equipment installed under this contract shall be new, unused, and without damage. The physical size of equivalent or substitute equipment shall not be larger than the space provided including space required for access and maintenance of equipment.

END OF SECTION

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SECTION 26 05 02
EXCAVATING, TRENCHING AND BACKFILLING

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Provide all trenching/backfill/compaction/surface restoration required to install all electrical as noted in drawings and specifications.
- B. Related Work:
 - 1. Section 26 05 34 - Conduit
 - 2. Division 31

1.02 QUALITY ASSURANCE:

- A. Engineer may have compaction tests taken by an independent testing laboratory. Cost will be paid by Owner unless tests indicate compaction does not meet Specifications in which case costs of initial test and any retesting will be paid by the Contractor and not charged to the Owner.
- B. Properly protect existing surfaces and items not included in this work and repair any damage to original condition.
- C. Take precautions to guard against movement, settlement, collapse, or other damage of existing construction and finish grade and repair any damage to original condition.
- D. Perform construction stakes, lines, and grades under direct supervision of a Registered Land Surveyor or Registered Civil Engineer.

1.03 EXISTING CONDITIONS:

- A. Determine exact locations of existing utilities before commencing work. Contractor is responsible for damages incurred by his failure to locate and preserve underground utilities. It is Contractor's responsibility to contact "One Call Locators" prior to performing any excavation.

PART 2 PRODUCTS

2.01 GENERAL BACKFILL REQUIREMENTS

- A. SPECIAL FILL GRAVEL (INSIDE BUILDING LINE):
 - 1. Washed type with 100% passing 3/4" sieve and gradation to ensure compactibility with no more than 5% passing No. 200 sieve.
- B. Outside Building Line: Native backfill.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Clear trenching work area in accordance with Division 31 requirements.
- B. Excavate to depths as indicated on drawings or as required by NEC, whichever is greater.
- C. Provide electrical ribbon marker tape above conduits in each trench.
- D. Notify Engineer immediately if during progress of work, subsurface conditions are encountered which are different from those ordinarily encountered.
- E. Excavated material, free from foreign material, may be used for backfilling outside building and rough grading. Stockpile as directed by Engineer. Remove any excess from site.
- F. Fill excavation below required depth with compacted special gravel fill.
- G. Protect bottom of excavation from frost and do not place structures or conduit on frozen ground.
- H. FILL WITHIN BUILDING (Under Concrete Slabs on Grade):
 - 1. Place and compact fill in successive layers not to exceed eight (8) inches before compaction. Compact to minimum of 95% per ASTM D698.
- I. At contractor's option, accessible nonorganic material from building excavating may be used for fill within building.
- J. Place a six-inch layer of Special Fill Material immediately below the floor slab.
- K. BACKFILL OUTSIDE BUILDING:
 - 1. Do not start backfilling until the work which will be covered is completed, areas are free of foreign material and Engineer has approved.
 - 2. Place and compact fill in successive layers not to exceed eight (8) inches before compaction. Compact to minimum of 95% per ASTM D698.
- L. Nonorganic material excavated from foundation areas may be used as backfill in exterior areas.
- M. Special care shall be given to ensure that the backfill under and adjacent to the transformer/generator pad(s) is fully compacted so that the pad doesn't settle.

END OF SECTION

SECTION 26 05 05
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
 - 1. Obtain permission from Owner at least 48 hours before partially or completely disabling system.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Repair adjacent construction and finishes damaged during demolition and extension work.

3.04 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.

END OF SECTION

SECTION 26 05 08
ELECTRICAL SERVICE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish and install an electrical service from 1 connection point(s) to the new electrical services at the facility shown on engineer's drawings.
2. Rocky Mountain Power (RMP) will provide a new 277/480V, 3PH, 4W Service.

B. Related Work:

1. Section 01 33 00 - Submittal Procedures
2. Section 01 35 16.01 - LEED 2009 Material Cost Summary Form
3. Section 26 05 19 - Power and Instrumentation Cable - Less Than 600V
4. Section 26 05 34 - Conduit
5. Section 26 36 00 - Automatic Transfer Switch

C. Associated Charges

1. All charges payable to RMP shall be paid by the Owner outside of this Contract.

1.02 QUALITY ASSURANCE

- A. NFPA 70 - National Electrical Code.

1.03 EXISTING CONDITIONS

- A. Contact the Utility Company for verification of the exact connection point for each service required.

PART 3 EXECUTION

2.01 INSTALLATION

- A. Verify requirements and installation locations with Utility Company before installation.
- B. Coordinate all temporary power services required as noted on the drawings with RMP during construction. All work requiring a power outage to any facility shall be coordinated with the Engineer and Owner 10 business days in advance.
- C. The serving electric Utility Company is:
1. RMP
 - a. Attn: A. Elio Perretta

- b. _____
- c. Email:Elio.Perretta@pacificorp.com

D. All work will be coordinated with Utility and Owner and scheduled for minimum of service interruption.

E. Summary of Site Electrical Service Installation:

1. Existing incoming primary utility service conductors to be removed from existing conduit by serving electric utility company.
2. Existing utility transformer to be disconnected and removed by serving electric utility company.
3. Electrical Contractor (EC) to remove existing utility transformer pad and secondary circuitry between transformer pad and existing utility metering cabinet.
4. EC to furnish and install new transformer pad and vault per serving electric utility company requirements.
5. Serving electric utility company to furnish and install new transformer on EC provided pad/vault.
6. EC to provide (6) 6" Schedule 80 PVC conduits from utility transformer vault to existing utility metering cabinet. Serving electric utility company to provide secondary service conductors from transformer to existing utility metering cabinet.
7. Serving electric utility company to provide conductor terminations at primary and secondary side of utility transformer and line side of existing utility metering cabinet.
8. Existing utility meter to be reused. Confirm requirements with serving electric utility company. Serving electric utility company to provide CT circuitry as needed.

END OF SECTION

SECTION 26 05 10

MOTORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Process equipment, ventilation and general-purpose motors.

1.02 REFERENCES

- A. Anti-Friction Bearing Manufacturers Association (AFBMA)
 - 1. Load Ratings and Fatigue Life for Ball Bearings
- B. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. IEEE 112, IEEE Standard Test Procedure for Polyphase Induction Motors and Generators
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70, National Electrical Code (NEC), Current Adopted Edition.
- D. National Electrical Manufacturer's Association (NEMA).
 - 1. NEMA MG 00001, Motors and Generators.
 - 2. NEMA EN 10250, Enclosures for Electrical Equipment.

1.03 SUBMITTALS

- A. Shop drawings and product literature in conformance with Division 01 and including:
 - 1. Dimension drawings
 - 2. Wiring diagrams
 - 3. Equipment mechanical and electrical specification sheets
 - 4. Efficiency information
- B. Submit operation and maintenance data in accordance with Division 01, unless such data is included in the data provided for individual equipment items.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Motors shall be covered and stored in a dry, warm (50°F) location prior to installation.
- B. Once installed, the space shall be heated and kept dry. The motor shall be covered until ready for service. Covering shall not trap moisture in the motor.
- C. All vertical turbine type motors of 50 HP and larger shall be shipped with tilt and vibration sensors. Motors delivered with sensors indicating results outside

manufacturer recommendations shall be recertified by factory representative prior to startup or final acceptance.

- D. Vertical Turbine type motors larger than 25HP in size shall be shipped in crates. Open mounted motors which are bolted to pallets for shipping shall not be accepted.

PART 2 PRODUCTS

2.01 MOTORS

- A. Motors shall conform with applicable NEMA, IEEE, and ANSI standards. Motors using non-standard frames or otherwise of special characteristics will be permitted only by special permission of the Engineer, the intent being to confine such usage to cases of absolute necessity.
- B. Motor ratings shall be based on current NEMA design standards for continuous duty and/or multiple starts per hour on motors through 100 horsepower. On motors larger than 100 horsepower starting shall be based on NEMA MG1-20.43 number of starts. Horsepower, torque, and speed characteristics shall be suitable for the full normal range of operating conditions of the driven equipment without exceeding 95% of the nameplate FLA and the temperature rise ratings regardless of size. Nameplate FLA shall be based on nameplate HP and shall not include the 15% S.F. In addition, all motors 1 horsepower and larger shall have a 1.15 service factor. Wherever horsepower ratings of motors proposed differ from those shown or specified, this fact shall be prominently noted on the shop drawings submitted, or otherwise brought to the attention of the Engineer.
- C. Process and major equipment drive motors shall be 3 phase, squirrel-cage induction type NEMA Design B, dual voltage in all sizes and types where this rating is standard. Larger motors and special motors where dual voltage construction is not available shall be furnished in ratings consistent with the nominal system voltage. Where process drives of fractional horsepower are required, standard frame 56 units shall be supplied. Such drives requiring limited power input shall employ overload heaters undersized accordingly.
- D. General purpose single phase motors, 1/3 HP and smaller, shall be 115 volt capacitor start type designed for continuous duty. Light duty motors of the domestic appliance variety will not be acceptable in this work. Bearings on frame 56 fractional horsepower motors shall be of the antifriction or sleeve type.
- E. The Division furnishing motors, or equipment containing or including motors, shall be responsible for delivery, handling and setting regardless of local agreements as to actual work jurisdiction. Further, this responsibility shall include checking of lubrication, drive alignment and condition, indication of proper rotation, and any or all other matters relating to operative readiness. When all checks are satisfactorily accomplished, the readiness of the unit for operation

shall be indicated by a conspicuous and legible tag installed by the responsible individual.

- F. As part of the operational test the responsible Division shall arrange for checking and recording of load current and verification of rating of overload heaters. No unattended operation of the equipment shall be permitted until completion of this procedure.
- G. Motor frames shall be totally enclosed fan cooled (TEFC) unless otherwise specified.
- H. All motors larger than NEMA 56 frame shall have antifriction (ball or roller) bearings, sized for a B10 life of at least 30,000 hours under normal loading conditions. Bearing shall be AFBMA standard sizes. Motors shall be equipped with end shield mounted ball bearings made to AFBMA standards and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against the entrance of foreign matter into the bearings, or leakage of grease out of the bearing cavity.
- I. Balance and Vibration:
 - 1. The vibration in any direction, as measured at the bearing housings, with the motors running at normal voltage and frequency, the shaft axis in normal position, and with one half of a standard key in the keyway shall conform with the following:

VIBRATION LIMITS

Maximum Permissible Total Amplitude
Peak to Peak (in.)

SYNCHRONOUS SPEED (RPM)

Frame Diameter Series	Below 1700	1700 - 3499	3500 & above
180,210,220	0.002	0.0015	0.001
250,280,320	0.002	0.0015	0.001
360,400,440	0.002	0.0015	0.001

- 1. If balancing weights are added to the rotor, they shall be permanently secured by welding, peening, or other method approved by the Engineer.
- J. Materials:
 - 1. Stator Frames and Endshields as follows:

- a. Drip-proof and Standard Duty – TEFC: Stator frames and endshields, may be cast aluminum, steel, or cast iron, whichever is manufacturer's standard.
 - b. Severe Duty - TEFC and Explosion Proof: Frames and endshields shall be cast iron for all frame sizes. Extruded aluminum frames will be considered with prior approval.
- 2. Other External Parts as Follows:
 - a. Drip-proof and Standard Duty - TEFC: Fan covers and conduit boxes may be cast iron, aluminum or steel, depending on manufacturer's standard.
 - b. Severe Duty - TEFC and Explosion Proof: Fan covers and conduit boxes shall be cast iron.
- K. Conduit Boxes:
 - 1. Conduit box mountings shall be arranged so conduit can be brought in from top, bottom or either side. Cast iron conduit boxes for all severe duty motors shall be tapped or threaded conduit connection. Conduit hole size shall conform to NEC Standards, depending on motor rating.
 - 2. For motors with parallel sets of cables or other field circumstances which require it, Contractor shall provide a new terminal box which meets the size requirements of the NEC.
- L. Eyebolts:
 - 1. All motors weighing more than 50 lbs. shall be drilled and tapped for a lifting eyebolt.
- M. Motor Leads:
 - 1. Motor leads into conduit box shall have same insulation class as the winding and be equipped with a numbered brass or copper terminal staked or otherwise mechanically fastened to the lead sufficient to resist 15 lbs. pull. Leads shall be marked throughout the entire length to provide identification after terminals are taped or clipped.
- N. Ventilating Fans:
 - 1. Drip-proof and TEFC: The fans forcing ventilating air through or over a motor may be steel, aluminum, or molded plastic, whichever is manufacturer's standard.
 - 2. Severe Duty - TEFC and Explosion Proof: Ventilating fans shall be non-sparking, abrasion and chemical resistant, cast brass or polypropylene.
- O. Shaft Seals:
 - 1. All severe duty motors and TEFC motors, 254 frame and larger, shall have a rotating seal or slinger located on the shaft at the drive end

endshield opening to prevent moisture or other foreign material from entering the bearing cavity.

P. Nameplates:

1. Aluminum nameplates may be used on drip-proof and standard TEFC motors. Severe duty enclosed motors shall have nameplates of stainless steel. Nameplates shall be stamped to include the following information:
 - a. Horsepower (not including 15% S.F.)
 - b. Speed
 - c. Time Rating
 - d. Frequency
 - e. Phases
 - f. Model Number
 - g. Rated Voltage
 - h. Service Factor (1.15 on all motors 1 HP and larger)
 - i. Full Load Amps (based on nameplate HP, not including 15% S.F.)
 - j. Insulation Class
 - k. NEMA Design
 - l. NEMA Code Letter
 - m. Maximum Ambient
 - n. Bearing Identification
 - o. Power Factor

Q. Connection Diagrams

1. The motor connection diagram shall be permanently attached to the motor either inside the conduit box or on the motor frame in a readable location from the conduit box side.

R. Locked Rotor Characteristics:

1. Unless shown otherwise, motors with a nameplate rating of 5 to 20 horsepower shall have a locked rotor characteristic not exceeding Code H. Motors with a nameplate rating of 25 through 50 horsepower shall not exceed NEMA Code G locked rotor characteristics. Motors larger than 50 horsepower shall not exceed NEMA Code F locked rotor characteristics.

S. Severe Duty:

1. Motors designated for severe duty shall have the following characteristics in addition to those designated in the specification:
 - a. Stainless steel nameplate.
 - b. Cast iron housing, bearing brackets, fan guard.
 - c. Cast iron conduit box.
 - d. Cast brass or polypropylene fan.
 - e. Zinc plated hardware.

- f. Minimum of 2 extra epoxy varnish, or equal, dips and bakes on windings.
- T. Inverter Duty (VFD Applications):
 - 1. Motors designated for inverter duty shall meet standard NEMA MG1 Part 31 in addition to the following characteristics:
 - a. Specifically designed for use with a solid-state inverter variable frequency drive (VFD).
 - b. Minimum service factor of 1.00 when operating from a VFD.
 - c. 1600V insulation system designed for inverter duty, Class F temperature rise minimum.
 - d. Insulated or insulated/ceramic bearing on the non-drive end of the motor to complement the bearing protection (shaft grounding) ring (installed on the drive end of the motor) in eliminating circulating currents for NEMA and IEC motors 75hp and larger. Specialty, non NEMA motors, such as those used in submersible type applications, do not require the installation of the bearing protection ring on the drive end of the motor or the insulated or insulated/ceramic bearing on the non-drive end of the motor.
 - e. Thermal switch embedded in the motor windings to stop the VFD on motor overtemperature condition. Normally closed contacts rated 5A at 120 VAC, nominal.
 - f. Include appropriately sized Aegis™ SGR bearing protection ring on all NEMA and IEC motors 75 hp or larger to eliminate circulating currents that could potentially damage the motor bearings. Coat motor shaft with Aegis™ “Colloidal Silver Shaft Coating” product, Part No. CS015 prior to the installation of the bearing protection ring. Confirm and coordinate the type of protection ring mounting (conductive epoxy, standard, split ring, bolt-thru, press-fit, etc.) best suited for the shaft/motor installation being furnished.
 - g. Motor horsepower full load amps shall not exceed NEC table 430-250.
- U. Heater:
 - 1. Where specified in the process equipment section, motors shall contain internal heaters to operate on 120 VAC to minimize condensation inside the motors. Unless otherwise required, the nominal heater size shall be 150 VA minimum.
- V. External Finish:

1. All motors shall be prime painted with corrosion resisting metal primer, and finish painted with a durable machinery gray enamel, manufacturer's standard unless otherwise specified.
2. All bolts, screws, and other external hardware shall be treated by zinc with iridite or zinc chromate for resistance to corrosion.

W. Testing:

1. Motor testing procedure shall be in accordance with the American Standard Test Code for polyphase induction motors and generators, IEEE 112A. All motors shall be given routine test to determine that they are free from electrical or mechanical defects. The routine test shall, as a minimum, conform to MG1-12.51.

X. Preparation for Shipment:

1. Before shipment, the shaft extension and any other bare exposed metal parts of each motor shall be coated with an easily removable rust preventative.
2. All motors shall be securely fastened to a hardwood skid or pallet for fork truck handling and be covered for protection against dirt and moisture during transit and for short time outdoor storage.

Y. Operating Characteristics:

1. Motors shall meet or exceed the starting locked rotor and maximum breakdown torques specified by NEMA for the NEMA design. The locked rotor starting currents shall not exceed NEMA maximum values for the specified NEMA design and rating. The current density and heating characteristics shall be such that the motors will not suffer damage if subjected to a maximum of ten (10) seconds stall at six times full load current. Except as noted, the services factor of the motor shall be in accordance with NEMA Standards. The insulation system of the motor shall be designed for 40,000 hours operation under usual service conditions as described under NEMA MG1-14.02. The motor manufacturer shall use IEEE standards to establish the suitability of the insulation system to meet these requirements.

Z. Energy Efficiency:

1. Motors of 1 horsepower and larger shall be of the premium efficient type. Energy efficient motors shall have a 1.15 service factor rating.
2. Efficiency shall be defined as the "NEMA Nominal Efficiency" at full load, as detailed in NEMA MG-1-12.54.1 and shall meet or exceed the values in the following tables. If a higher value is specified in the respective equipment section, then the higher value shall apply.

FULL LOAD EFFICIENCIES OF PREMIUM EFFICIENT MOTORS

OPEN MOTORS			HP	CLOSED MOTORS		
1200 RPM	1800 RPM	3600 RPM		1200 RPM	1800 RPM	3600 RPM
82.5	85.5	77.0	1.0	82.5	85.5	77.0
86.5	86.5	84.0	1.5	87.5	86.5	84.0
87.5	86.5	85.5	2.0	88.5	86.5	85.5
88.5	89.5	85.5	3.0	89.5	89.5	86.5
89.5	89.5	86.5	5.0	89.5	89.5	88.5
90.2	91.0	88.5	7.5	91.0	91.7	89.5
91.7	91.7	89.5	10.0	91.0	91.7	90.2
91.7	93.0	90.2	15.0	91.7	92.4	91.0
92.4	93.0	91.0	20.0	91.7	93.0	91.0
93.0	93.6	91.7	25.0	93.0	93.6	91.7
93.6	94.1	91.7	30.0	93.0	93.6	91.7
94.1	94.1	92.4	40.0	94.1	94.1	92.4
94.1	94.5	93.0	50.0	94.1	94.5	93.0
94.5	95.0	93.6	60.0	94.5	95.0	93.6
94.5	95.0	93.6	75.0	94.5	95.4	93.6
95.0	95.4	93.6	100.0	95.0	95.4	94.1
95.0	95.4	94.1	125.0	95.0	95.4	95.0
95.4	95.4	94.1	150.0	95.8	95.8	95.0
95.4	95.8	95.0	200.0	95.8	96.2	95.4
95.4	95.8	95.0	250.0	95.8	96.2	95.8
95.4	95.8	95.4	300.0	95.8	96.2	95.8
95.4	95.8	95.4	350.0	95.8	96.2	95.8
95.8	95.8	95.8	400.0	95.8	96.2	95.8
96.2	96.2	95.8	450.0	95.8	96.2	95.8
96.2	96.2	95.8	500.0	95.8	96.2	95.8

PART 3 EXECUTION

3.01 INSTALLATION

- A. All wire terminations within the motor termination j-box for 480V class motors and below shall be performed by means of utilizing insulated connector blocks in lieu of wire nuts or split bolt connectors and mastic tape. The insulated connector blocks shall be manufactured by Polaris, IlSCO, or equal.

3.02 SUBMITTALS

- A. Contractor shall fill out and submit attached "Motor Data Sheet" for each project motor as part of shop drawings submittals. Contractor shall copy the attached

Motor Data Sheet as required for submitting on all project motors. See Motor Data Sheet located at the end of this Section.

- B. Contractor shall fill out and submit the attached "Pump/ Equipment Control Data Sheet" for each project motor driven equipment item as part of the shop drawing submittals. Contractor shall copy the attached Pump/ Equipment Control Data Sheet as required for submittals for all project motor driven equipment. See Pump/ Equipment Control Data Sheet located at the end of this Section.

3.03 START UP

- A. Check lubrication, drive alignment and condition, indication of proper rotation, and other matters relating to operative readiness. When all checks are satisfactorily accomplished, the readiness of the unit for operation shall be indicated by a conspicuous and legible tag.
- B. Arrange for checking and recording of load current and verification of rating of overload heaters. No unattended operation of equipment shall be permitted until completion of this procedure.

MOTOR DATA SHEET

JOB NO. _____ CONTRACT NO. _____
TAG NO. _____ DESCRIPTION _____

NAMEPLATE DATA

MFG _____ TYPE _____ FRAME _____
HP _____ DESIGN _____ PHASE _____
VOLTS _____ AMPS _____ INS. CLASS _____ DESIGN RISE (C) _____
NEMA CODE LETTER _____ POWER FACTOR _____ MAX AMBIENT (C) _____
ENCLOSURE TYPE _____ S.F. ON A-T-L START _____ S.F. ON VFD _____
WEIGHT (LBS) _____ LUBRICATION TYPE _____
INVERTER DUTY (Y/N) _____ INSULATED BEARING ON NON DRIVE END (Y/N) _____
TYPE/ MATERIAL OF BEARINGS (DRIVE END) _____
TYPE/MATERIAL OF BEARINGS (NON DRIVE END) _____

PERFORMANCE DATA

NEMA NOMINAL EFFICIENCY AT FULL LOAD (%) _____
GUARANTEED EFFICIENCY AT FULL LOAD (%) _____ $\frac{3}{4}$ LOAD _____ $\frac{1}{2}$ LOAD _____
POWER FACTOR AT FULL LOAD (%) _____ $\frac{3}{4}$ LOAD _____ $\frac{1}{2}$ LOAD _____
NO LOAD AMPS _____ MAX KVAR _____

THERMAL DATA ROTOR INERTIA

(LB-FT SQ.) _____ LOAD INERTIA (LB-FT SQ.) _____ LOCKED ROTOR
AMPERES: AT MAXIMUM RATED TERMINAL VOLTAGE (100%) _____ AT
SPECIFIED TERMINAL VOLTAGE (____ %) _____ AT MINIMUM
RATED TERMINAL VOLTAGE (____ %) _____ ACCELERATION TIME
(SECONDS) OF MOTOR PLUS LOAD: AT MAXIMUM RATED TERMINAL VOLTAGE
(100%) _____ AT SPECIFIED TERMINAL VOLTAGE
(____ %) _____ AT MINIMUM RATED TERMINAL VOLTAGE
(____ %) _____ SAFE STALL TIME (SECONDS): AMBIENT _____
RUNNING _____ MAXIMUM STARTS PER HOUR _____

ACCESSORY DATA THERMAL SWITCHES

(Y/N) _____ TYPE/ MFR/ MODEL _____ TRIP TEMP (C) _____ STATOR RTDS:
TYPE _____ OHMS _____ QUANTITY _____ TRIP/ALARM TEMP (C) _____ BEARING RTDS:
TYPE _____ OHMS _____ QUANTITY _____ TRIP/ALARM TEMP (C) _____

PUMP/ EQUIPMENT CONTROL DATA SHEET

JOB NO. _____ CONTRACT NO. _____
TAG NO. _____ DESCRIPTION _____

NAMEPLATE DATA AND STARTING METHOD PUMP OR EQUIPMENT

MFG _____ TYPE/ MODEL _____ BRAKE HORSEPOWER
REQUIREMENT OF DRIVEN LOAD BASED ON DESIGN CRITERIA
(HP) _____ MOTOR MFG _____ TYPE/
MODEL _____ HP _____ RPM _____
DESIGN _____ PHASE _____ VOLTS _____ AMPS _____
MAXIMUM AMBIENT OPERATING TEMP (C) _____ TYPE OF MOTOR STARTING
METHOD DESIGNED AROUND: A-T-L START, ELECTRONIC SOFT START, VFD
START (CIRCLE ONE). SUITABLE FOR USE ON A-T-L STARTING METHOD
(Y/N) _____ SUITABLE FOR USE ON ELECTRONIC SOFT
STARTING METHOD (Y/N) _____ SUITABLE FOR USE ON VFD STARTING
METHOD (Y/N) _____ MOTOR OVERLOAD PROTECTION
CLASS REQUIRED (CLASS 10, CLASS 20, CLASS 30) – CIRCLE ONE

CONTROL REQUIREMENTS MINIMUM START UP VOLTAGE

(%) X RATED VOLTAGE _____ MINIMUM START UP CURRENT
(%) X FULL LOAD AMPS _____ MAXIMUM RAMP UP TIME
FROM STOPPED CONDITION TO MINIMUM SPEED (SEC) _____ MIN
OPERATING SPEED (RPM) _____ MAX OPERATING SPEED (RPM) _____ MIN
OPERATING SPEED (HZ) _____ MAX OPERATING SPEED (HZ) _____
MINIMUM FLOW (FPS) _____ MINIMUM FLOW (GPM) _____ IS
A DUAL SLOPE RAMP ON START UP REQUIRED? (Y/N) _____ IF
A SINGLE SLOPE OR DUAL SLOPE RAMP ON START UP IS BEING PROVIDED,
WHAT IS THE MAXIMUM ALLOWABLE RAMP TIME FOR ATTAINING MINIMUM
SPEED FROM A STOPPED CONDITION (SEC) _____ MAXIMUM RAMP DOWN TIME
FROM MINIMUM RUNNING SPEED TO STOPPED (SEC) _____ IS THERE A REED
CRITICAL FREQUENCY OR SKIP FREQUENCY THAT SHOULD BE AVOIDED?
(Y/N) _____ IF THERE IS A FREQUENCY OR FREQUENCY BAND THAT
SHOULD BE AVOIDED FOR MOTOR OPERATION, WHAT IS IT
?(HZ) _____ IF OPERATION IS FROM A VFD, WHAT METHOD OF
VFD CONTROL IS SUGGESTED OR PREFERRED (VOLTS/HERTZ, SENSOR-LESS
VECTOR, OTHER?) PLEASE FILL IN _____

END OF SECTION

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SECTION 26 05 19

POWER AND INSTRUMENTATION CABLE - LESS THAN 600V

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Furnish and install all conductors to accomplish the circuiting, control and power distribution as shown in the Drawings.
- B. Related Work:
 - 1. Section 26 05 34 - Conduit
 - 2. Section 26 05 53 - Identification for Electrical Systems

1.02 REFERENCE STANDARDS:

- A. UL 486A-486B - Wire connectors
- B. NEMA WC 70
- C. NEMA WC30-1976
- D. NFPA 70 (National Electrical Code)
- E. NFPA 79

1.03 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver conductors to project on standard coils or reels and suitably protected from weather and damage during storage and handling.

PART 2 PRODUCTS

2.01 CONDUCTORS

- A. Type P1 - 600V Rated General Purpose Single Conductor Cable
 - 1. Construction:
 - a. No. 14 AWG and larger: Stranded Copper, (THHN/THWN-2). Solid Copper is acceptable for lighting and branch circuits.
 - b. All conductors shall contain factory color coded insulation in all standard colors to match the voltage level used.
 - c. Sequential footage markers shall be factory installed on the insulation jacket.
 - d. Provide Cable Tray (CT) rated cable where installed in cable tray.
 - e. Aluminum conductors are not permitted.
 - 2. Feeder Conductors:
 - a. 98 percent conductivity copper, 600-volt insulation.

3. Branch Circuit Conductors:
 - a. 98 percent conductivity copper, 600-volt insulation.
 - b. Conductors smaller than No. 14 AWG are not permitted except in control panel.
4. Project Use Areas:
 - a. All general use indoor building circuiting.
 - b. Not allowed for any VFD output circuitry
5. Manufacturer:
 - a. Service Wire Co.
 - b. Okonite Co.
 - c. Southwire
 - d. Belden
 - e. Alpha Wire

B. Type P2 - 600V Rated Special Purpose Single Conductor Cable

1. Construction:
 - a. XHHW-2 insulation which is moisture, heat, and flame-retardant cross-linked polyethylene covered with an overall flame retardant, moisture and sunlight resistant PVC jacket.
 - b. Stranded Copper
 - c. All conductors shall contain factory color coded insulation in all standard colors to match the voltage level used.
 - d. Sequential footage markers shall be factory installed on the insulation jacket.
 - e. Provide Cable Tray (CT) rated cable if installed in cable tray.
 - f. Aluminum conductors are not permitted.
2. Project Use Areas:
 - a. All 600V and less service entrance conductors and feeders routed underground from the exterior to the interior.
3. Manufacturer:
 - a. Service Wire Co.
 - b. Okonite Co.
 - c. Southwire
 - d. Belden
 - e. Alpha Wire

C. Type P4 - Multiconductor Shielded VFD Cable

1. Sizes #16 AWG through #2 AWG
 - a. Construction:
 - 1) Three stranded, Class D, tin plated copper conductors with XLPE (crosslinked polyethylene) insulation.
 - 2) Overall shield + 85% TC braid plus full-size TC drain wire.
 - 3) Black sunlight-and oil-resistant PVC jacket.

- 4) One full-sized insulated ground conductor.
 - 5) Cable construction for direct-buried applications shall include interlocked, corrugated aluminum armor protection.
- b. Ratings/Listings:
 - 1) 1000V UL Flexible Motor Supply
 - 2) 600V UL 1277 Type TC-ER per the NEC.
 - 3) 1000V UL 2277 Type WTTC
 - 4) IEEE 1202/383
 - 5) UL Direct Burial
 - 6) 90 deg C Wet/Dry
 - 7) UL 1685 Vertical Tray Flame Test
 - 8) CE approved
2. Sizes #1 AWG through #4/0 AWG
 - a. Construction:
 - 1) Three stranded, Class D, tin plated copper conductors with XLPE (crosslinked polyethylene) insulation.
 - 2) Two spiral copper tape shields with 100% coverage.
 - 3) Black sunlight-and oil-resistant PVC jacket.
 - 4) Three symmetrical bare copper grounds.
 - 5) Cable construction for direct buried applications shall include interlocked, corrugated aluminum armor protection.
 - b. Ratings/Listings:
 - 1) 1000V UL Flexible Motor Supply
 - 2) 600V UL 1277 Type TC-ER per the NEC.
 - 3) 1000V UL 2277 Type WTTC
 - 4) IEEE 1202/383
 - 5) UL Direct Burial
 - 6) 90 deg C Wet/Dry
 - 7) UL 1685 Vertical Tray Flame Test
 - 8) CE approved
3. Project Use Areas:
 - a. Motor branch circuit conductors for all VFD driven motors from the VFD to the motor.
 - b. Cables which pass through Hazardous Areas shall be rated for the environment and installed to meet all Article 500 NEC requirements.
4. Manufactures:
 - a. Belden Series 29500
 - b. Service Wire Co. Equal
 - c. Okonite Co. Equal
 - d. Southwire Equal
 - e. Alpha Wire Equal

D. Type C1 - Multiconductor Control Cable

1. Construction
 - a. Conductor quantity and size as shown on the Drawings
 - b. Insulation: High dielectric strength, heat and moisture-resistant, colored PVC rated for continuous 90 deg C dry or wet to meet UL-83 requirements for Type THHN or THWN-2 wire.
 - c. Conductor group bound with spiral wrap of barrier tape
 - d. Color Code: In accordance with ICEA, Method 1, with printed number.
 - e. Overall Jacket: A flame-retardant sunlight-resistant black PVC jacket.
2. Ratings/Listings
 - a. UL 1581 listed as Type THHN/THWN rated VW-1
 - b. UL 83
 - c. Passes the ICEA T-29-520 210,000 Btu per hour Flame Test.
 - d. TC-ER Rated
3. Project Use Areas:
 - a. Use cable for all control circuiting requiring numerous conductors from a control panel to a field instrument or similar application.
 - b. Cables which pass through Hazardous Areas shall be rated for the environment and installed to meet all Article 500 NEC requirements.
4. Manufactures:
 - a. Service Wire Co.
 - b. Okonite Co.
 - c. Southwire
 - d. Belden
 - e. Alpha Wire

E. Type S1 - Signal Cable - Single Pair - Shielded/Twisted

1. Construction
 - a. NFPA 70, Type CMP Single pair, twisted, 100% shield coverage, Class B, 16 AWG, stranded (19 x 29) tinned copper conductors (7 strand minimum).
 - b. 600V minimum insulation rating
 - c. 15 mil (nominal), 90 deg C PVC primary insulation with a flame retardant, low smoke PVC, plenum rated.
 - d. Conductors shall be shielded with a .35 x 5 mil (min.), 100% coverage, aluminum or copper mylar tape shield, or equal with an 18-gauge strand copper drain wire.
2. Ratings/Listings:
 - a. Flame Resistance: Comply with UL 1685 & NFPA 262
 - b. UL Temperature Rating: 75 deg C Dry, 90 deg C wet

- c. ICEA S-73-532, S-61-402
- 3. Project Use Areas:
 - a. Use cable for all control circuiting requiring one shielded twisted pair from a control panel to a field instrument or similar application.
- 4. Manufactures:
 - a. Service Wire Co.
 - b. Okonite Co.
 - c. Southwire
 - d. Belden
 - e. Alpha Wire

F. Type D3 - Cat 6 Shielded Ethernet Cable

- 1. EIA/TIA Category 6, 4-pair, 23 AWG, and a 600V rating
- 2. FEP Teflon plenum rated premise wiring cable where required.
- 3. Characteristics:
 - a. Industrial grade PO insulation
 - b. Minimum of 100% overall foil shielding coverage
 - c. PVC inner and out jackets
 - d. Outdoor rated
- 4. Category 6 cables shall all be terminated in eight-conductor TIA-568-B CAT6, RJ-45 compliant snagless modular connectors.
- 5. Note: All Category 6 Cable to be used for process control related purposes including connections to VFDs, starters, other MCC mounted components, connections to control panels, and the like shall utilize this cable type
- 6. The cable jacket and RJ45 terminator color shall be as follows:
 - a. SCADA Network: Black Jack with Red adhesive jack label
 - b. Admin Network: Black Jack with Blue adhesive jack label
- 7. Project Use Areas:
 - a. Network circuiting as defined on the cable and conduit schedule
- 8. Manufactures:
 - a. Belden 7953A
 - b. Approved Equal

G. Type D4 - Cat 6 Ethernet Cable

- 1. EIA/TIA Category 6, 4-pair, 23 AWG, and the voltage rating is application dependent
- 2. FEP Teflon plenum rated premise wiring cable where required.
- 3. Category 6 cables shall all be terminated in eight-conductor TIA-568-B CAT6, RJ-45 compliant snagless modular connectors.
- 4. The cable jacket and RJ45 terminator color shall be as follows:
 - a. SCADA Network: Orange

- b. Admin Network: White
- 5. Project Use Areas:
 - a. Network circuiting as defined on the cable and conduit schedule
- 6. Manufactures:
 - a. Belden
 - b. Mohawk/CDT
 - c. Approved Equal

2.02 CORD CONNECTOR GRIPS

- A. Manufacturer: Killark "Z" series or equal
- B. Type: Aluminum cord connector, stainless steel mesh grips, straight or 90° as required in eliminating sharp cable bending radii.
- C. Use: To support all cables/cords from the enclosure at their point of use and/or wherever cables/cords enter or leave the bottom of conduit risers (above grade). Required for all cord connections to motors or enclosures.

2.03 BOLTED, PRESSURE TYPE CONNECTORS

- A. Manufacturer: Burndy or equal
- B. Use: Connecting conductors to busbars, suitable for copper and aluminum conductors.
- C. Size: As required for conductor.

2.04 SOLDERLESS CONNECTORS

- A. Manufacturer: 3M "Scotchlok" or equal
- B. Type: Twist-on, spring tension.
- C. Use: With copper conductors only.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All conductors shall be installed within conduit or approved raceway unless noted otherwise on drawings.
- B. Draw conductors into conduit only after conduit system is complete. Install in a manner so as not to injure insulation.
- C. Use stranded, copper conductors only. Solid conductors are not acceptable.
- D. Make splices on branch circuit conductors with solderless stapleless, mechanical wire connectors.
- E. Tighten bolted, pressure type connectors to manufacturer's recommendations.

- F. No. 10 AWG and smaller shall be stranded copper for all motor and control circuits. Branch circuits for lighting and convenience outlets shall be solid copper.
- G. All branch circuit homeruns greater than 50 feet shall be #10 minimum.
- H. Make splices and terminations in control panel by using bolted, pressure type connections. Install according to manufacturer's recommendations.
- I. Provide strain relief cord connectors and stainless-steel mesh on all cords entering motor termination boxes, junction boxes or conduits.
- J. Use factory color coded conductors with separate color for each phase and neutral conductor by integral pigmentation for all conductor sizes.
- K. Use following codes:

CONDUCTOR SYSTEM VOLTAGE-120/240, SINGLE PHASE

Phase A	Black
Phase B	Red
Neutral	White
Equipment Ground	Green

CONDUCTOR SYSTEM VOLTAGE-277/480, THREE PHASE

Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	Gray
Equipment Ground	Green

- L. Lace or clip groups of feeder conductors in control panels, pull boxes, and wireways.
- M. Use wiring pulling lubricant for pulling No. 4 AWG and larger wire.
- N. Splice only in accessible junction or outlet boxes.
- O. VFD Output Circuit Requirements:
 - 1. VFD output circuits shall be installed via one of the following methods at the Contractor's option:
 - a. Building wire in dedicated rigid steel conduit.
 - 1) Type P1 cable is not acceptable
 - 2) Must be one of the following types:
 - (a) RHH
 - (b) RHW
 - (c) RHW-2
 - (d) XHH
 - (e) XHHW
 - (f) XHHW-2

- (g) Other approved types according to NFPA 79 and other applicable standards
- b. Type P4 Specialty shielded VFD cable in Sch.80 PVC conduit below grade, and rigid metal/aluminum conduit above grade as defined on the Electrical Drawings.
- 2. The ground conductor(s) from the VFD output shall be bonded to the motor frame or motor/equipment ground lug.
- 3. Each VFD output circuit shall be installed in its own dedicated conduit. No sharing of circuitry with VFD output power conductors in a common conduit or raceway system is allowed.
- 4. Ensure submersible well casing has been bonded to the VFD ground in accordance with manufacturer requirements, and applicable standards.
- 5. VFD output circuitry shall be installed to minimize their proximity to other power, signal and control circuits. A minimum separation of 6 inches is suggested between exposed VFD output circuits and other circuits in junction boxes, panels, MCCs, etc. Long parallel runs (10 feet or longer) of VFD output conductors with other circuits are not suggested or allowed. Maximum separation (more than 6") and maximum shielding (via metal conduit or shielded output cable) methods of installation shall be utilized wherever possible. Extra costs for installation revisions due to the inadequacy of the installed VFD output circuit separation and shielding will not be considered. It is the Contractor's responsibility to provide a complete and fully functioning VFD system with no output circuit interference, noise, crosstalk, etc.
- 6. See Section 26 24 19 - Motor Control Centers for specific additional requirements for MCC construction with VFDs included.

3.02 CABLE INSTALLATION CERTIFICATIONS

- A. Installations and terminations of Ethernet network cabling shall be performed by BICSI Installer 2 certified installers with INSTC certifications.
- B. Contractor shall submit installer certification to project engineer prior to installation of any network cabling.

3.03 CABLE TESTING

- A. Type D4 Cable - Telephone and LAN Category 6 Cable Testing
 - 1. Perform end to end tests of each voice and data cable installed as follows:
 - a. Pair/conductor for proper pinouts and continuity.
 - b. Ground fault.
 - c. Proper termination, shorts and crossed pairs.
 - d. Channel attenuation per ANSI/TIA/EIA-568-A-5 and TSB-95.

- e. Channel bidirectional worst case near end cross talk (NEXT) at frequencies up to 100 MHZ, per the standards listed in Item 4.
- f. Measured and documented effective cable run length for each circuit.
- g. Submit record of test results to Owner and Engineer.

END OF SECTION

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish and install a complete grounding system for all electrical equipment at the facility. Also, provide equipotential ground loop where shown on the Drawings and bond to main service equipment. Furnish and install accessible ground bars and ground test wells throughout the facility at locations indicated on the Drawings.

1.02 DESCRIPTION OF SYSTEM

- A. Bond electrical equipment, control panels, panelboards, etc. to the metallic conduit system through conduit connectors or bonding jumpers, as required, to provide effective electrical continuity.

1.03 QUALITY ASSURANCE

- A. NFPA 70, Article 250 National Electrical Code (NEC), current adopted Edition

PART 2 PRODUCTS

2.01 GROUNDING CONDUCTORS

- A. Copper, with green identification as specified in Section 26 05 19 - Power and Instrumentation Cable - Less Than 600V.

2.02 GROUND RODS

- A. Type: Copper clad steel, 5/8-inch diameter, 10 feet long.

2.03 GROUND CLAMPS (CONCEALED)

- A. Compression type grounding which meets IEEE 837.
B. Manufacturer: Panduit StructuredGround

2.04 GROUND FITTINGS AND LUGS (EXPOSED)

- A. Manufacturer: Equal to Burndy Company

2.05 GROUND LUG

- A. Located in electrical equipment as indicated on the Drawings.

2.06 GROUND ACCESS WELL

- A. Open bottom rectangular well with access cover for testing and inspection of ground system.
- B. Include a cover that is identified by permanent means with the word "GROUND".

PART 3 EXECUTION

3.01 POWER SYSTEM GROUNDING

- A. Main Service
 - 1. Provide a grounding grid consisting of driven ground rods with #4/0 bare stranded copper interconnecting conductor and a connection to water service ground as indicated on the Drawings. From two points on the ground grid, provide ground conductor to the ground bars indicated on the Drawings. From the service ground bus, provide ground conductor to neutral of main service (main bonding jumper strap). Also bond all equipment to equipotential ground plane where noted on the Drawings.
- B. Distribution System
 - 1. Install grounding bars and grounding studs at locations indicated within the facility, distribution centers, pull boxes and panelboards. Bond all metallic conduit systems and metallic piping with metallic clamps and bonding conductor for ground continuity.
- C. Provide a properly sized copper grounding conductor in all branch circuit and feeder conduits. Size the conductor according to Table 250-122 of the National Electrical Code. Connect the grounding conductor to grounding points (grounding bars, ground studs, etc.) in all electrical enclosures, electrical equipment, junction boxes and outlet boxes.
- D. Ground and bond in accordance with National Electrical Code, Article 250.

END OF SECTION

SECTION 26 05 34

CONDUIT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish and install a complete conduit system for all conductors. Low voltage control conductors shall be installed within the conduit as well.

B. Related Work:

1. Section 26 05 02 - Excavating, Trenching and Backfilling
2. Section 26 05 19 - Power and Instrumentation Cable - Less Than 600V
3. Section 26 05 37 - Boxes
4. Section 26 05 53 - Identification for Electrical Systems

1.02 REFERENCE STANDARDS:

- A. U.L. 6 - Rigid metal conduit.
- B. U.L. 360 - Liquid-tight flexible steel conduit.
- C. U.L. 651 - Rigid non-metallic conduit.
- D. NEMA Standard Publication TC-2 - Rigid PVC for underground installations.
- E. NEMA Standard Publication RN 1-2005 – PVC coated rigid steel conduit.

1.03 DELIVERY, STORAGE AND HANDLING:

- A. Store in a dry area, protected from the weather.

PART 2 PRODUCTS

2.01 RIGID METAL CONDUIT

- A. Manufacturer: Equal to the Wheatland Steel Company
- B. Type: Steel heavy wall; galvanized unless noted otherwise on Drawings.
- C. Minimum trade size is 3/4-inch; other sizes as required by NEC based on quantity of conductors.

2.02 PVC EXTERNALLY COATED RIGID CONDUIT

- A. Manufacturer: Equal to Plasti-Bond
- B. Type:
 1. PVC externally coated, galvanized steel.

- C. Minimum trade size is 3/4"; other sizes as required by NEC based on quantity of conductors.
- D. The PVC coated galvanized rigid conduit must be ETL Verified to the Intertek ETL SEMKO High Temperature H2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

2.03 FLEXIBLE METAL CONDUIT (LIQUID-TIGHT)

- A. Manufacturer: Equal to Alfalex
- B. Type: Steel
- C. Weatherproof covering

2.04 EXPANSION FITTINGS

- A. Manufacturer: Equal to OZ Electrical Manufacturing Company.
- B. Minimum trade size is 3/4-inch.
- C. Material type to match conduit.

2.05 HANGERS AND SUPPORTS

- A. Manufacturer: Equal to B-Line Products.

2.06 SURFACE METAL WIREWAY

- A. Manufacturer: Equal to Hoffman or Walker
- B. Type: Lay-in with hinged cover and suitable fittings. Provide integral barrier where shown on the Drawings.
- C. NEMA 12, NEMA 4 or NEMA 4X construction as called for on Drawings.
- D. All areas noted as Class I, Division 1, Group D or Class I, Division 2, Group D shall require equipment listed for use in those specific areas.

2.07 CONDUIT SEALS

- A. Manufacturer: Equal to Appleton.
- B. Type: Minimum trade size is 3/4-inch; other sizes as required for conduit sizes.
- C. Provide listed seal offs throughout Class I, Division 1, Group D or Class I, Division 2, Group D areas per NEC Articles 500 and 501.
- D. All seals shall be field marked when poured.

2.08 NON-METALLIC CONDUIT - PVC (HEAVY WALL)

- A. Manufacturer: Equal to Carlon.

- B. Minimum trade size is 3/4-inch.
- C. Type: Schedule 80 polyvinyl chloride, except where Schedule 40 is specifically called for on Drawings.

2.09 NON-METALLIC EXPANSION FITTINGS

- A. Manufacturer: Equal to Carlon.
- B. Type: Suitable for use with nonmetallic conduit.
- C. Minimum trade size is 3/4-inch.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Size conduits as shown on the Drawings or as required by National Electrical Code (whichever is larger) for number and size of conductors installed.
- B. The minimum trade size for home runs is 3/4-inch.
- C. Contractor shall not exceed 270 degrees of bend in any single conduit run without an additional pull point unless otherwise noted in drawings.
- D. All raceways shall have an equipment ground conductor installed. The raceway shall not be utilized as an EGC.
- E. Support all conduits from structural system, independent of ductwork, ceiling system supports and main runners. Do not support conduit from conduit.
- F. Cut conduit joints square and ream smooth. Make bends with an approved bender or utilize standard conduit elbows.
- G. Building walls are mainly concrete or concrete blocks. Contractor shall core drill walls or coordinate reinforced, boxed out areas as required to install all conduit in a neat and workmanlike manner. Contractor shall also patch all wall penetrations and prepare the surface for final paint by General Contractor. Coordinate routing of larger conduits (3" and larger) with other trades and with Field Engineer prior to installation.
- H. Contractor shall provide sleeves or reinforced concrete boxed out openings through footings for all underground conduits. Coordinate with General Contractor.
- I. Securely fasten conduit and raceways with malleable iron clamps (hot dipped galvanized, with clamp backs), or galvanized unistrut and hangers with suitable fastenings for all indoor dry applications. Utilize stainless steel unistrut and clamps for all exterior applications, indoor damp/corrosive areas, and all areas as noted on the Drawings. The intent is to keep an air gap between conduit and finished wall surfaces to reduce the potential of moisture induced corrosion. All

anchors shall be expansion type constructed of stainless steel or lead with stainless steel hardware. Route all conduits parallel to and at right angles to building lines. Conduits mounted directly in contact with wall surface will not be acceptable.

- J. Tie wires to hang or strap conduits are not permitted.
- K. Route conduit continuous from outlet to outlet, outlet to cabinets, outlet to pull or junction boxes. Secure conduit to all boxes with locknuts and bushings in such a manner that each system is electrically continuous throughout.
- L. Surface mount conduit in all areas, unless noted otherwise. All conduits and outlet boxes on the building exterior shall be flush mounted where possible. If not, install conduits within the building and then penetrate the wall directly into the back of light/outlet/etc. Intent is to eliminate/minimize the usage of surface mounted conduit on the exterior face of the building.
- M. Cap ends of conduit to prevent entrance of foreign materials during construction.
- N. Locate conduits poured in concrete entirely in the middle 1/3 of the concrete member.
- O. Provide a 4-inch-high watertight barrier for conduits that pass vertically through a floor with a metal sleeve or concrete curb.
- P. Provide "link seal" around all conduits penetrating exterior walls/foundations and wet wells. Nuts on the link seal shall remain accessible from inside the building once link seal is installed. Non shrinking grout is acceptable for penetrations above finished grade.
- Q. Below grade non-metallic conduit shall be transitioned to PVC Coated Rigid Steel before exposing above grade. Transition shall be made via below grade transition couplings to PVC Coated Rigid Steel elbows/sweeps.
- R. Provide watertight installation where conduits pass through roof, wall or waterproofing membranes.
- S. Conduit systems must be installed completely before conductors are pulled in.
- T. Repair any damage done to insulation or interior vapor barrier where any conduit enters air plenums.
- U. Fill conduits which can admit air to or release air from air plenums through the connecting conduit system with sealing compound.
- V. Provide firestopping around all conduits penetrating fire rated walls as determined by the Architect and Engineer.

3.02 CAST IN PLACE CONDUIT INSTALLATION REQUIREMENTS

- A. Conduits installed under the concrete floor within the extents of the building footprint will not be acceptable unless specifically called out on drawings.
- B. Structures with deep basements and foundation systems consisting of piles/screwed piers with grade beams and void forms shall have no conduits under the concrete floor under any circumstances.
- C. Where conduits transition from below the concrete floor to above, any vertically oriented couplings installed below slab shall be with threaded PVC coated rigid type. All other conduit types shall have no vertical couplings and be seamless and continuous from horizontal coupling to above concrete floor.
 - 1. Do not route conduits through wet wells, clearwells, underground tanks, etc. unless required to feed equipment located within the same. Use PVC coated RMC sweeps whenever penetrating concrete floors or through below grade footings, etc. Schedule 80 PVC conduits shall be used under or cast into concrete floor slabs.
- D. Schedule 80 PVC Conduit shall be used in concrete encased ductbanks. See Section 26 05 43 - Underground Duct and Raceways for Electrical Systems for additional requirements.
- E. VFD Output Circuits and Signal Circuits shall be installed in PVC conduit as noted above and utilize shielded VFD cable and shielded signal cable respectively.
- F. Contractor shall submit a cast-in-place conduit routing plan showing conduit routes, sizes and quantity to Structural Engineer prior to any cast-in-place installation taking place.

3.03 RIGID METAL CONDUIT

- A. Metallic:
 - 1. Rigid Metal Conduit is required for all exposed conduits unless otherwise noted on the Drawings.
 - 2. Paint rigid metal conduit that is in contact with earth with heavy coat of bitumastic paint. Paint couplings after assembly. Where bitumastic paint is applied the paint must be thoroughly dried before backfilling.
 - 3. Fittings type to be threaded. Use threaded hubs (equal to Myers hub) where rigid conduit is connected to a thread less box or enclosure for indoor and outdoor applications. Lock nut with O-Ring is not an acceptable alternative.

3.04 FLEXIBLE METAL CONDUIT (LFMC):

- A. Use rain tight flexible metal conduit with rain tight fittings for final connections to motors (non-hazardous areas), and field instrumentation (non-hazardous areas) that do not come with factory installed cords. Minimum trade size is 1/2-inch.
- B. Length shall be limited to trade size: 3/4" or less = 36"; 1" or larger = 48". Minimum 12". Use permitted only to avoid transmission of vibration or noise and where flexibility to entry is required. All other uses shall be approved by the Engineer.
- C. Engineer reserves the right to request re-work of all flexible metal conduit exceeding lengths exceeding specified or installed where not permitted as noted above.
- D. Flexible Metal Conduit shall not be used to transition through walls under any circumstance.

3.05 RIGID NON-METALLIC PVC CONDUIT (HEAVY WALL)

- A. Use rigid non-metallic, Schedule 80 PVC conduit for all direct burial and exposed wet, caustic or corrosive installations unless specifically noted otherwise on Drawings. Cut conduit square with round edges removed from ends to protect the wires from abrasion. Make connections by solvent welding. Install fittings in accordance with the manufacturer's recommended procedures. All elbows 2" and larger shall be rigid metal conduit. Provide expansion joints wherever there are long runs of conduit, and a wide temperature differential exists. Use PVC coated RMC sweeps whenever penetrating through concrete floors.
- B. Provide grounding conductor in all control circuits, branch circuits and feeder conduits.
- C. Typical applications included underground and in chemical or caustic areas.

END OF SECTION

SECTION 26 05 37

BOXES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish and install all outlet boxes, junction boxes and pull boxes required to accomplish device and equipment installation, wire pulling shown on the Drawings and to comply with National Electrical Code requirements for conduit and conductor installation.

B. Related Work:

1. Section 26 05 19 - Power and Instrumentation Cable - Less Than 600V
2. Section 26 05 34 - Conduit
3. Section 26 27 26 - Wiring Devices

1.02 SHOP DRAWINGS AND PRODUCT DATA:

- A. Submit in accordance with Specification Section 01 33 00 - Submittal Procedures.**

1.03 WORK INSTALLED BUT FURNISHED BY OTHERS:

- A. Back boxes for selected items of equipment are furnished by the equipment supplier. Refer to individual Specification Sections for mounting, size, etc.**

1.04 REFERENCE STANDARDS:

- A. U.L.**
- B. NEMA**
- C. NFPA 70 - National Electrical Code (NEC), current adopted Edition.**

1.05 DELIVERY, STORAGE AND HANDLING:

- A. Store materials in a dry area, protected from the weather.**

PART 2 PRODUCTS

2.01 PULL BOXES

- A. Manufacturer: Hoffman or Equal**
- B. Type: Metal construction, conforming to National Electrical Code, with screw on or hinged cover, unless specifically noted otherwise on drawings.**
- C. NEMA 12, 4, 4X, 7 as noted in the drawings.**

- D. Overlapping covers with flush head cover retaining screws, prime coated for flush mounted pull boxes.

2.02 SURFACE MOUNTED OUTLETS

- A. Manufacturer: Crouse Hinds, Appleton, or equal.
- B. Type: FS or FD Condulet Cast Device Boxes (# gangs as required).
- C. Matching iron alloy (Feraloy) covers as required for device(s) used.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Coordinate work with other trades to avoid potential obstructions within dedicated equipment spaces and work clearances as defined in the NEC.
- B. Clean interior of boxes to remove dirt, debris, and other foreign materials.
- C. Do not use sectional or handy boxes.
- D. Protect outlet boxes from entrance of foreign materials, including paint, during the construction period.
- E. Surface mount all interior outlet boxes.
- F. Install outlets at the heights and approximate designated positions as shown on the Drawings or indicated in Specifications, unless specifically noted otherwise.
- G. Locate outlets to clear piping, access hatches, and other obstructions.
- H. Install switch outlets on latch side of door except where type of construction dictates otherwise.
- I. Mounting heights indicated on Drawings are to center line of outlet unless indicated otherwise.
- J. Pull boxes and junction boxes are not indicated on Drawings except for special requirements. Install pull boxes or junction boxes as required to facilitate pulling wire. Size pull boxes and junction boxes as required by the National Electrical Code.
- K. Mount receptacles in the equipment rooms and in other unfinished areas at 48 inches unless noted otherwise on drawings. Match mounting heights of similar existing devices in the immediate area if present.
- L. All conduits entering pull boxes shall have the conduit ID as shown on the cable and conduit schedule clearly labeled on the inside of the pull box using permanent marker.
- M. Boxes shall not be penetrated from the top.
- N. Provide ventilated skirt under junction boxes where indicated on the drawings.

END OF SECTION

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SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Equipment to be identified includes panelboards, disconnects, transformers, relays, contactors, system control panels, variable frequency drives, separately mounted control stations, pilot lights, control switches and all wires and terminations.
- B. Related Work:
 - 1. Section 26 05 34 - Conduit
 - 2. Section 26 24 13 - Switchboards
 - 3. Section 26 24 16 - Panelboards
 - 4. Section 26 24 19 - Motor Control Centers
 - 5. Section 26 28 18 - Enclosed Switches
 - 6. Section 26 29 13 - Enclosed Controllers
 - 7. Section 26 29 23 - Variable Frequency Motor Controllers
 - 8. Section 26 32 13 - Engine Generators
 - 9. Section 26 36 00 - Automatic Transfer Switch
 - 10. Section 40 70 01 - Instrumentation General Requirements

1.02 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code (NEC), current adopted Edition.
- B. OSHA

PART 2 PRODUCTS

2.01 INSTRUCTION SIGNS

- A. Plastic sandwich-type acrylic based construction of contrasting colors equal to Rowmark. Engraving through the top layer exposes inner layer.
- B. Color: Black with white letters.
- C. Letters: 1/8-inch height, standard block type.
- D. Punched or drilled for mechanical fasteners. Fasteners shall be self-tapping stainless-steel screws with nuts and flat lock washers.

2.02 EQUIPMENT IDENTIFICATION LABELS

- A. Self-adhered, engraved, laminated acrylic or melamine label.

- B. Color: Black with white letters.
- C. Letters: 3/8-inch minimum height, standard block type.
- D. Punched or drilled for mechanical fasteners. Fasteners shall be self-tapping stainless-steel screws with nuts and flat lock washers.

2.03 WIRE MARKERS

- A. All wires requiring circuit indication shall be permanently fastened type written. No handwritten labels shall be acceptable.
- B. Wire markers shall be Shrink Tube or Self Laminating type as specified below.
- C. Shrink Tubing type wire markers:
 - 1. All shrink tube type markers shall be type written with circuit indication.
 - 2. 3:1 heat-shrinking type
 - 3. Resistant to chemicals, grease, oil and cleaning agents.
 - 4. Material shall be Polyolefin with smudge-proof finish.
 - 5. Material shall be cold resistant and flame-retardant
 - 6. Temperature range: -67 to 275 degrees Fahrenheit.
 - 7. Manufacturer: Brady or equal
- D. Self-laminating type wire markers:
 - 1. All self-laminating type markers shall be type written with circuit indication
 - 2. Vinyl label with acrylic adhesive
 - 3. Label shall have overlamine included sized appropriately to wrap cable one and a half times or completely cover printed area, whichever is greater.
 - 4. Label shall be rated for indoor and outdoor use.
 - 5. Temperature range: -94 to 140 degrees Fahrenheit.
 - 6. Material shall be flame-retardant.
 - 7. Resistant to chemicals, humidity, oil, water and weather.
 - 8. Manufacturer: Brady or equal

2.04 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and OSHA 29 CFR 1910.145.
- B. Self-adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated. Weather resistant, non-fading, metal backed or baked enamel signs to be used for outdoor installations.

2.05 POWER SOURCE LABELS FOR EQUIPMENT AND DEVICES

- A. Self-adhered label, installed on the front cover, door, or other access to equipment and devices unless otherwise indicated. Weather resistant, non-fading, metal backed or baked enamel signs to be used for outdoor installations.

- B. Self-adhesive labels shall be Brady or equal.
- C. Apply to all panels, junction boxes, receptacle faceplates, switch faceplates, front covers, doors, or other access to equipment unless otherwise indicated. See Part 3 for Execution.

2.06 CABLE AND CONDUIT IDENTIFICATION

- A. Each cable or conduit shall be identified using a permanent identification system consisting of a round 304 stainless steel engraved tag secured to the cable or conduit 6" from entry at both ends. Install tag in suitable location readable from normally accessed side.
- B. The following information shall be provided on each conduit label:
 - 1. Line #1 - Conduit ID found on the Cable and Conduit Schedule (where applicable)

PART 3 EXECUTION

3.01 INSTALLATION

- A. Clean surface before installation of any self-adhered labels.
- B. Identify with black acrylic based placard with white engraved letters mounted with drive pins or other approved fasteners.

3.02 DISCONNECTS AND STARTER ENCLOSURES

- A. Use the following for identifying disconnects or starter enclosures per NEC 110.22 (A).
 - 1. EXAMPLE: Raw Wastewater Pump #1
480 volt, 3 phase, 300 H.P.
Fed from: DP-X, Pole Position XX

3.03 SWITCHBOARDS, MCC & PANELBOARD LABELING

- A. Label per NEC Article 408.4 (A) & (B) and with the following information: Panel name, voltage, phase and amperage/type of main.
 - 1. EXAMPLE:
Panel L: Fed From: DP-X
120/208 volt
Three phase
225 amp Main Circuit Breaker
- B. Provide each panelboard with a neatly typed directory, with clear plastic cover, of circuits describing loads served.

- C. All markings are to be plainly visible, fit over the insulation of the conductor and begin 1/8" from where the insulation begins.
- D. Wire markers shall be provided by the Contractor and placed on both ends of all wires prior to termination.
- E. All wiring shall be checked for circuit completeness to verify correct circuiting, identification and labeling at the terminals. Terminal markings and wire markings shall match "record schematics" as provided by Hardware System Integrator.
- F. Hand lettering of identification not permitted. Completely remove temporary labels used during construction and repaint surfaces if required.

3.04 POWER SOURCE LABELS FOR EQUIPMENT AND DEVICES

- A. Provide a mechanically fastened power source label at all equipment and devices with the following information:
 - 1. EXAMPLE: LPA-11 or LPA-13,15 or DPA-1,3,5.
- B. All equipment and devices such as panels, junction boxes, receptacle faceplates, switch faceplates, front covers, doors, or other access to equipment shall include an adhesive backed label that indicates the power source for said equipment.

3.05 CONDUIT AND CIRCUIT LABELING AT POINT OF ENTRY TO LARGE ENCLOSURES

- A. Use a black permanent marker and hand label all conduits and circuits at the point of entry to large enclosures (control panels, pullboxes, junction boxes, motor control centers, etc.) with the conduit/circuit number from the Cable and Conduit Schedule.
- B. Labeling shall be done on the interior of the enclosure or on the floor near each conduit/circuit, or on the conduit itself in some cases. All conduits/circuits that enter enclosures shall be labeled.
- C. Labeling with a permanent marker shall be in addition to any circuit tags installed around the cables themselves.

3.06 GROUNDED (NEUTRAL) CONDUCTOR IDENTIFICATION

- A. Follow NEC 200.6. In addition to the part (D) identification requirements for the grounded conductor when different systems are in close proximity - Example: Non-Emergency UPS and Utility power sharing a common junction box or multi-channel raceway. Where broken, to prevent crossing of grounded/neutral conductors, the non-utility system's neutral wires shall all have wire markers identifying it as the system to which it belongs.

3.07 DRY TYPE TRANSFORMER

- A. Label per NEC Article 450.11 and with the following information: Transformer name, power source and circuit number, and loads served.

1. Example: XFMR-1
Fed from: DP-X-12,14,16
Feeds LP-X

END OF SECTION

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SECTION 26 13 50
PROTECTIVE RELAYS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Customer metering as specified herein will be incorporated into this project and connected to MCC-1 as shown on the Drawings.

1.02 SUBMITTALS

A. Submit shop drawings and product data in accordance with Specification Section 01 33 00 - Submittal Procedures including, at a minimum:

1. Detail equipment assemblies and indicate dimensions, weights, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.03 OPERATION AND MAINTENANCE DATA

A. Include and submit manufacturer's data for each type of product included. Data should include the following items, minimum:

1. Detailed operation and maintenance information/schedule for all equipment and component items, field quality control and startup/commissioning reports, warranty information, description of system operation, troubleshooting, repair parts list and suggested spare parts with list prices.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Schweitzer Engineering Laboratories, Inc. (SEL)
- B. Or Approved Equal
- C. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 POWER QUALITY AND CUSTOMER METERING

- A. The power quality and customer meter shall have the following features:
1. Enclosure
 - a. NEMA 4 Enclosure with FT-1 Test Switch
 2. Power Supply
 - a. 110-240 VAC 60Hz
 3. Metering
 - a. Class 0.1 revenue metering accuracy
 - b. CL2/10/20 current class and 57–277 V voltage metering
 - c. 60 Hz system frequency metering
 4. Hardware
 - a. Conformal Coating
 - b. Vertical chassis
 - c. 5-inch color touchscreen display
 - d. 1 GB of recording memory
 - e. 125/250 Vdc or Vac power supply
 - f. Two 125 Vdc or Vac digital inputs and three electromechanical outputs
 - g. Form 9 Four-Wire Wye; 3 PTs, 3 CTs
 5. Communications
 - a. Modbus TCP/IP
 - b. 10/100BASE-T copper Ethernet port
 - c. EIA-232 rear serial port
 - d. EIA-485 rear serial port
 6. Power Quality
 - a. IEC 61000-4-30 Class A monitoring
 - b. 512 samples-per-cycle waveform capture
 - c. 63rd-order harmonic metering
 - d. Voltage and current interharmonics
 - e. Flicker measurement
 - f. 600 VSSI summary events
 - g. 512 channels of energy and PQ trending
 - h. Wave View
- B. Schedule:
1. SW57-PQM1
- C. Manufacturer:
1. Schweitzer Engineering Laboratories - (SEL-735)

PART 3 EXECUTION

3.01 INSTALLATION AND TESTING

- A. All devices noted shall be tested onsite.

3.02 SITE PROGRAMMING

- A. All programming is to be completed by the Owner

3.03 WARRANTY

- A. Warranty. The device shall include a 10-year, no-questions asked warranty for all material and workmanship defects. In addition, the warranty shall cover accidental customer-induced damage.

END OF SECTION

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SECTION 26 22 13
GENERAL PURPOSE DRY-TYPE DISTRIBUTION TRANSFORMER (1500 KVA AND
BELOW)

PART 1 GENERAL

1.01 SCOPE

- A. The Contractor shall furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

1.02 REFERENCES

- A. The transformers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI, NEMA and UL.
- B. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

1.03 SUBMITTALS – FOR REVIEW/APPROVAL

- A. The following information shall be submitted to the Engineer:
 - 1. Outline dimensions and weights
 - 2. Transformer ratings including:
 - a. kVA
 - b. Primary and secondary voltage
 - c. Taps
 - d. Basic impulse level (BIL) for equipment over 600 volts
 - e. Design impedance
 - f. Insulation class and temperature rise
 - g. Sound level.
 - 3. Product data sheets

1.04 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes.
 - 1. Final as-built drawings and information for items listed in "SUBMITTALS - REVIEW/APPROVAL", and shall incorporate all changes made during the manufacturing process
 - 2. Connection diagrams
 - 3. Installation information
 - 4. Seismic certification and equipment anchorage details as specified

1.05 QUALIFICATIONS

- A. The manufacturer of the dry-type distribution transformers shall be the same as the manufacturer of the other major electrical distribution equipment on the project.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer shall be a participant in the UL Data Acceptance Program (DAP) under the Client Test Data Program (CTDP) certification to ensure UL test methodologies and record traceability complies with the requirements of ISO 17025.
- D. Transformer must bear the UL Energy Efficiency Verification Mark to confirm that the unit meets the requirements of 10 CFR Part 431.
- E. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

1.06 REGULATORY REQUIREMENTS

- A. All transformers shall be UL listed and bear the UL label.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.08 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Eaton
- B. Square D
- C. Siemens
- D. General Electric
- E. ABB
- F. Sola/Heavy-duty

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 RATINGS

- A. The kVA and voltage ratings shall be as indicated on the drawings.
- B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.
- C. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".
- D. Transformers efficiency shall be measured according to federal law 10 CFR Part 431.
- E. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

	Self-Cooled Ventilated		Self-Cooled Sealed
	K-Factor=1 K-Factor=4 K-Factor=9	K-Factor=13 K-Factor=20	
Equivalent Winding kVA Range			
3.00 and below	40	40	45
3.01 to 9.00	40	40	45
9.01 to 15.00	45	45	50
15.01 to 30.00	45	45	50
30.01 to 50.00	45	48	50
50.01 to 75.00	50	53	55
75.01 to 112.50	50	53	55
112.51 to	50	53	55

150.00	55	58	57
150.01 to 225.00	55	58	57
225.01 to 300.00	60	63	59
300.01 to 500.00	62	65	61
500.01 to 700.00	64	67	63
700.01 to 1000.00	Consult Factory	Consult Factory	Consult Factory
Greater than 1000			

- F. Where K-factor transformers are indicated on the drawings, the transformers shall be specifically designed to supply circuits with a harmonic profile equal to or less than a K-factor of 20 without exceeding 115 degrees C temperature rise.

2.03 CONSTRUCTION – GENERAL PURPOSE TRANSFORMERS

A. Insulation Systems

1. Transformer insulation system shall be as follows:
 - a. Less than 15 kVA: 180 degrees C insulation system with 115 degree C rise, encapsulated design; 15 kVA and above: minimum of 200 degree C insulation system with 115 degree C rise, ventilated design.
 - b. 1 – 75 kVA, three-phase (37.5 kVA, single-phase): 180 degrees C insulation system with 80 degree C rise, encapsulated design; 5-45 kVA minimum of 200 degrees C insulation system with 115 degree C rise; 50 kVA and above: minimum of 220 degrees C insulation system with 115 degree C rise, ventilated design.
2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient, and a 24-hour average ambient of 30 degrees C.
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

B. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction.
2. On three-phase units rated 75kVA and below and single-phase units rated 37.5kVA and below the core and coil assembly shall be completely encapsulated in a proportioned mixture of epoxy or resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.
3. On three-phase units rated 15kVA and above and single-phase units rated 15kVA and above the coils assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture; the core shall be coated with HAPs (Hazardous Air Pollutants) free water reducible electrical varnish to give good corrosion resistance. The assembly shall be installed on vibration-absorbing pads.
4. Terminals shall be welded to the leads of the coils for better conductivity, less maintenance, and lower risk of hot spots. Terminals shall not be spot welded or bolted to the coil leads.

C. Taps

1. Three-phase transformers rated 15 through 225 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage. Three-phase transformers rated greater than 225 kVA shall be provided with manufacturer's standard taps for that rating.
2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer's standard tap configuration.

D. Electrostatic Shielding

1. Where shown on the drawings, provide shielded isolation transformers with an electrostatic shield consisting of a single turn of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.
 - a. Electrostatic shield shall provide primary to secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.
 - b. Electrostatic shielding shall provide the following minimum attenuation when tested per MIL-Std-220A, Method of Insertion Loss Measurement, with matched impedance no load technique:

2. Common mode noise attenuation: Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz; minus 55 dBA minimum at 1.51 kHz to 100 kHz. Normal mode (Transverse mode) noise attenuation: Minus 35dBA minimum at 1.5 kHz to 10 kHz.

E. Motor Drive Isolation

1. Where shown on the drawings, provide motor drive isolation transformers.
2. Motor drive isolation transformers shall be designed for use with three-phase ac adjustable frequency drives 600 volts and below to provide isolation between the incoming line and drive circuitry. These drives minimize the line disturbances caused by SCR firing within the drive unit. Thermoguards shall be included in all motor drive isolation transformers to provide additional protection for the transformer from increased heating due to the non-sinusoidal characteristics of drive currents. The transformer shall provide reduced short-circuit currents and voltage line transients. The transformer shall be specifically sized to the drive kVA requirements dictated by the horsepower of the motor and, as such, will be mechanically braced to withstand the stress of current reversals and short-circuit currents associated with the specific drive kVA rating.

2.04 CONSTRUCTION – K-FACTOR TRANSFORMERS

A. Insulation Systems

1. Transformers shall be insulated with a UL recognized minimum 200 degrees C insulation system.
2. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient and a 24-hour average ambient of 30 degrees C.
3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

B. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade aluminum with continuous wound construction. The core shall provide reduced induced currents in the steel caused by the high ratios of peak-to-rms currents and voltages found in harmonic loads.

2. The neutral bus shall be configured to accommodate 200% of the rated current.
 3. The coils assembly shall be impregnated with non-hygroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture; the core shall be coated with HAPs (Hazardous Air Pollutants) free water reducible electrical varnish to give good corrosion resistance. The assembly shall be installed on vibration-absorbing pads.
- C. Taps
1. Three-phase K-factor rated transformers through 225 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage. Three-phase transformers rated greater than 225 kVA shall be provided with the manufacturer's standard taps for that rating.
 2. Single-phase K-factor rated transformers shall be provided with manufacturer's standard tap configuration.
- D. Electrostatic Shielding
1. Provide K-rated transformers with electrostatic shielding consisting of a single turn of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.
 - a. Electrostatic shield shall provide primary to secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.
 - b. Electrostatic shielding shall provide the following minimum attenuation when tested per MIL-Std-220A, Method of Insertion Loss Measurement, with matched impedance no load technique:
 - c. Common mode noise attenuation: Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz; minus 55 dBA minimum at 1.51 kHz to 100 kHz. Normal mode (Transverse mode) noise attenuation: Minus 35dBA minimum at 1.5 kHz to 10 kHz.

2.05 CONSTRUCTION – HARMONIC MITIGATING TRANSFORMERS

- A. Core and Coil Assemblies
1. Transformer core shall be constructed with high-grade, non-aging electrical steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed.
 2. The coils assembly shall be impregnated with non-hygroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture; the core shall be coated with HAPs (Hazardous Air Pollutants)

free water reducible electrical varnish to give good corrosion resistance. The internal core and coil assembly shall be installed on vibration-absorbing pads.

3. Transformers shall be of two-winding construction. The primary winding shall be a delta, three-wire connection and the secondary winding shall be wye-zigzag with a wye field connection.
4. Primary and secondary windings shall be wound of electrical grade aluminum with continuous wound construction. All terminals and bussing shall be aluminum.
5. Transformers shall be insulated with a UL recognized minimum 200 degrees C insulation system. Winding temperature rise shall not exceed 80 degrees C.
6. Required performance shall be obtained without exceeding the above indicated temperature rise in a 40 degrees C maximum ambient, and a 24-hour average ambient of 30 degrees C.
7. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.
8. Neutral conductor shall be aluminum and rated to carry 200% of normal phase current.
9. Windings shall have a BIL of 10 KV.

B. Taps

1. Three-phase harmonic mitigating transformers rated 15 through 225 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage. Three-phase transformers rated greater than 225 kVA shall be provided with manufacturer's standard taps for that rating.

C. Electrostatic Shielding

1. Harmonic mitigating transformers shall be provided with an independent, single, full-width electrostatic shield consisting of a single turn of aluminum placed between each primary and secondary winding and grounded.
 - a. Electrostatic shield shall provide primary to secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.
 - b. Electrostatic shielding shall provide the following minimum attenuation when tested per MIL-Std-220A, Method of Insertion Loss Measurement, with matched impedance no load technique:
 - c. Common mode noise attenuation: Minus 80 dBA minimum at 0.1 kHz to 1.5 kHz; minus 55 dBA minimum at 1.51 kHz to 100 kHz. Normal mode (Transverse mode) noise attenuation: Minus 35dBA minimum at 1.5 kHz to 10 kHz.

2.06 HARMONIC TREATMENT

- A. Harmonic Mitigating Transformers (HMTs) shall have a low Positive/Negative sequence impedance (between 4.6% and 7.2%) and low Zero-Sequence impedance/reactance (less than 0.55% and 0.47% respectively)
- B. Triplen harmonics shall be treated in the secondary windings through flux cancellation and not coupled in to the primary delta winding.
- C. 5th and 7th harmonic currents shall be treated through the pairing of phase-shifted transformers such that these harmonic currents subtract at the common bus feeding the transformers with harmonics produced by other similar sources.
- D. Each of the transformers used to treat 5th and 7th harmonic currents shall also treat triplen harmonics in the secondary windings of each transformer.
- E. Fundamental current imbalance shall be reduced on the primary when compared to the secondary load measurements.
- F. Harmonic treatment shall be through electromagnetic means; filters, capacitors, power electronic circuitry or other such devices shall not be used to treat harmonics.
- G. Thermal Sensors
 - 1. When required, provide transformers with a thermal sensor set at 190 degrees C. Provide a second thermal sensor set at 175 degrees C when required. Thermal sensor(s) shall be factory-installed in the center coil of the transformer and factory-wired to a terminal strip. Thermal sensors shall consist of a set of dry contacts.

2.07 WIRING/TERMINATIONS

- A. Recommended external cable shall be rated 90 degrees C (sized at 75 degrees C ampacity) for encapsulated and 75 degrees C for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.

2.08 ENCLOSURE

- A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C per UL requirement. The core of the transformer shall be grounded to the enclosure.
- B. On three-phase units rated 75kVA and below and single-phase units rated 37.5kVA and below the enclosure construction shall be encapsulated, totally

enclosed, non-ventilated, NEMA rating as defined on drawings, with lifting provisions.

- C. On three-phase units rated 15kVA and above and single-phase units rated 15kVA and above the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting provisions. All ventilation openings shall be protected against falling dirt. On outdoor units, provide weathershields over ventilated openings.
- D. Ventilated type transformers that meet 10 CFR Part 431 efficiency requirements, with a core size of 150 kVA or less, shall be suitable for installation with 2-inch clearance from a wall or other obstruction behind the transformer enclosure.

2.09 FINISH

- A. Steel enclosures shall be finished with ANSI 61 color, weather-resistant enamel. Stainless steel enclosures shall not be painted.

2.10 OPTIONAL ACCESSORIES

- A. On ventilated outdoor units provide suitable weathershields over ventilation openings.
- B. Lug kits shall be provided by the Manufacturer of the transformer.
- C. Provide hinged, padlockable front cover to facilitate visual inspection and infrared scanning.
- D. Provide infrared viewing windows of size and quantity to scan the terminals of the transformer.

PART 3 EXECUTION

3.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 - 1. Ratio tests at the rated voltage connection and at all tap connections
 - 2. Polarity and phase relation tests on the rated voltage connection
 - 3. Applied potential tests
 - 4. Induced potential test
 - 5. No-load and excitation current at rated voltage on the rated voltage connection

3.02 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.03 FIELD ADJUSTMENTS

- A. Adjust taps to deliver appropriate secondary voltage.

3.04 FIELD TESTING

- A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION

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SECTION 26 24 16
PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Furnish and install circuit breaker type panelboards for branch circuit distribution to lighting, general receptacle and small motor loads.
- B. Related Work:
 - 1. Section 26 05 19 - Power and Instrumentation Cable - Less Than 600V
 - 2. Section 26 05 34 - Conduit
 - 3. Section 26 05 53 - Identification for Electrical Systems
 - 4. Section 26 43 00 - Surge Protective Devices

1.02 QUALITY ASSURANCE

- A. NEMA PB-2
- B. U.L. listed

1.03 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit in accordance with Specification Section 01 33 00 - Submittal Procedures.
- B. Clearly indicate (for each panelboard) amperage and phase of main bus, amperage of main circuit breaker, wire size and quantity of main lugs, grounding bar location, neutral bar location, quantity, arrangement and amperage of branch circuit breakers, quantity of spaces, physical dimension of enclosure, weight, directory card location and type, type of lock, flush or surface cover, short circuit withstand rating in R.M.S. amperes.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Box, crate, or otherwise completely enclose and protect all equipment during shipment, handling, and storage.
- B. Protect equipment from exposure to elements and keep all items thoroughly dry at all times.
- C. Store in a dry area, protected from the weather.
- D. Painted Surfaces: Protect against impact, abrasion, discoloration, and other damage.

1.05 OPERATION AND MAINTENANCE DATA

- A. Include manufacturer's instructions in accordance with Specification Section 01 35 16.01 - LEED 2009 Material Cost Summary Form for maintenance, including cleaning, tightening conductor connections, testing, and addition or replacement of circuit breakers.

PART 2 PRODUCTS

2.01 LIGHTING AND APPLIANCE PANELS (120/208V OR 120/240V)

- A. Utilize lighting and appliance panels (denoted by L prefix) for 120/208 volt, 3 phase operation or 120/240V for single phase operation as indicated on the Drawings. Install bolt-on, thermal magnetic circuit breakers with a minimum interrupting rating of 22,000 amperes R.M.S. unless noted otherwise on Drawings.
- B. Circuit breakers shall have a trip indication different from the "off" or "on" position.
- C. Install in a NEMA 1 surface mount enclosure, unless indicated otherwise on the Drawings. Provide a hinged front breaker access door and a separate hinged front cover (two separate hinges) for personnel/contractor access without completely removing front panelboard cover.
- D. Install common trip multipole circuit breakers. Handle ties are not permitted.
- E. Full cabinet height bussing includes active, spare and blank breaker locations with sizes, branches, mounting, main circuit breakers, etc., as shown in Schedule on the Drawings.
- F. Provide adequate wiring space according to the National Electrical Code.
- G. Provide wall mount panels with a hinged door with lock. Key locks alike. Covers shall be square with surface not extending past edges of panelboard where wall mounted.
- H. Isolated neutral bar and ground bar in all panelboards. Provide 200% rated neutrals where indicated on the Drawings.
- I. Provide distributed phase bussing.
- J. Metal framed circuit directory and card with plastic covering located on the inside.
- K. Tin-plated copper bussing, SPD protection and additional requirements as noted on Panelboard "L" Schedule on Drawings.
- L. Provide a integral SPD per Section 26 43 00 - Surge Protective Devices on all panelboards where defined on the Drawings. SPD shall have disconnect sized per manufacturer recommendations.

2.02 MANUFACTURERS

A. Lighting and Appliance Panels (L Prefix):

1. Square D Type NQ
2. General Electric equal
3. Siemens equal
4. ABB
5. Cutler Hammer equal

2.03 CABLE TIES

A. Equal to Thomas and Betts "TY-RAP"

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install all panelboards plumb with top at 72" above the finished floor.
- B. Type circuit directory with spare positions left blank. Hand lettering not acceptable.
- C. Carefully clean panelboard to remove all wire scraps, dirt and dust.
- D. Neatly dress conductors and bundle with nylon cable ties.
- E. Tighten all lugs and bolts to manufacturer's recommendations.
- F. Use touch up paint, as recommended by the manufacturer, to repair scratches and other surface defects.
- G. Install SPD as recommended by the manufacturer at each project panelboard. Install with leads as short as possible so that SPD indicating lights are visible.

END OF SECTION

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SECTION 26 24 19
MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish and install motor control centers complete with starters and control accessories as shown on the Drawings. It is the intent of this Specification that all project MCC equipment be provided and integrated into the project, complete with NEMA Class IIS, Type B wiring/interconnection diagrams by the Contractor.
2. Motor control centers shall include all motor starters, circuit breakers, electronic soft starters, power monitors, power supplies, reduced voltage soft starters, and related equipment as indicated on the Drawings.

1.02 DESCRIPTION OF SYSTEM

- A. Factory assembled, metal enclosed motor control center for distribution and control of power from incoming line terminals to motors installed and tested in place. Complete assembly includes starters and controls. Type II-B construction complete with Type II-B wiring diagrams provided by the Contractor. All units shall be interwired and tested as a Class IIS MCC.
- B. Each motor starter, soft starter, and related device shall be supplied with a means to communicate all I/O via modbus TCP and shall have the capability of monitoring at least 4 discrete input points and 2 discrete output point, minimum, or as otherwise indicated on the Drawings. Provide additional I/O cards as required to match required I/O on the drawings.
- C. All motor control center equipment shall be installed within the MCC enclosures, and the enclosures shall fit within the spaces designated and as shown on the Drawings. Contractor/Supplier shall confirm that adequate building space exists for the Supplier's proposed equipment.

1.03 QUALITY ASSURANCE

A. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code (NEC)

B. National Electrical Manufacturer's Association (NEMA)

1. NEMA ICS 1 General Standards for Industrial Control and Systems
2. NEMA ICS 2 Industrial Control Devices, Controllers and Assemblies
3. NEMA 250 Enclosures for Electrical Equipment
4. NEMA CP-1 Capacitors

- C. Underwriter's Laboratories (UL)
 - 1. UL 845 Electric Motor Control Centers

1.04 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit in accordance with Specification Section 01 33 00 - Submittal Procedures.
- B. Clearly indicate concrete pad dimensions, conduit entrance area, electrical ratings, nameplate nomenclature, single line diagrams, bus bar size and type, switch amperage and location, short circuit withstand rating, starter controls, starter type and location, schematic wiring diagrams for starters.
- C. Submit schematics and wiring diagrams for each starter, VFD, and related device provided in the motor control center.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Lift motor control center using eyes, yokes, and skids provided by manufacturer.
- B. Store motor control center in a dry area, protected from the weather.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's instructions in accordance with Specification Section 01 78 23 - Operation and Maintenance Data for tightening bus connections, performing cleaning, operating and maintaining motor control center, repair parts list.
- B. Submit "as-built" schematic and wiring diagrams for each device installed in the motor control center

1.07 PROVIDE SEISMIC TESTED EQUIPMENT AS FOLLOWS:

- A. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC).
- B. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
- C. The IP rating of the equipment shall be 1.5
- D. The Structural Engineer for the Site will evaluate the SDS values published by the Manufacturer to ascertain that they are "equal to" or "greater than" those required for the Project Site.
- E. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
 2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- F. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

PART 2 PRODUCTS

2.01 MOTOR CONTROL CENTER

- A. Type and General Requirements:
1. Class II, Type B, NEMA 1, gasketed.
 2. Total enclosed freestanding.
 3. Arrangement of starters, VFDs and related equipment as shown on the Drawings.
 4. Engraved nameplate identification.
 5. Tin-plated copper bussing (ratings as shown on the Drawings).
 6. Voltage as shown on the Drawings.
 7. Equipment ground bus (full length of enclosure). Neutral bar where required and/or indicated on the Drawings.
 8. Standard finish.
 9. Design individual sections for bolting together at installation site.
 10. Horizontal neutral plate.
 11. Short circuit withstand rating as shown on the Drawings.
 12. Circuit breaker disconnect (magnetic) for each starter. Thermal magnetic circuit breakers for all feeders.
 13. For all 3 phase non-VFD driven motors, provide factory wired single phasing protection using electronic overload relays that are suitable for providing single phasing protection.
 14. Additional feeder/distribution circuit breakers per MCC Schedules on Drawings.
 15. Additional requirements per MCC Schedules, One-lines and Details on Drawings.
- B. Motor control centers shall be of the indoor type, with Class II Type B construction in accordance with the applicable NEMA standards. The motor

control centers shall be factory assembled with combination starters, and other components and equipment as shown. The proposed motor control center layouts shall be approved by the Engineer. It is the intent that components and systems identified on motor control center one line diagrams and schematic diagrams be furnished by the manufacturer of the motor control center. Motor control centers shall bear the U.L. label and shall bear a U.L. "suitable for use as service entrance equipment" label.

C. Ratings

1. The rating of the motor control centers shall be as follows:
 - a. Voltage: 277/480 Volts
 - b. Frequency: 60 Hz
 - c. Phases: 3
 - d. Control Voltage: 120 VAC
2. The current capacity of the horizontal main bus shall be as shown on the drawings and the current capacity of the vertical riser bus shall be 300 amps minimum or as required for the application. The momentary capacity of the bus shall not be less than as shown on the One-line Diagrams.

D. The motor control center shall be of the unitized metal enclosed type with NEMA Type 1 enclosure. Sections shall be nominally 90 inches high, 20 inches wide and 20 inches deep, joined together to form a rigid, free standing completely deadfront assembly. The motor control centers shall be of Class II Type B construction in accordance with the applicable NEMA standards. The motor control centers shall be arranged and bussed to accommodate removable units and so that units may be mounted front only. Doors and access panels shall be flanged with the corners welded and ground smooth. All metal parts of the frame and all panels shall be painted on all sides. Each section shall be for not more than 6-1/2 space factor utilization. All components shall be mounted inside starter or auxiliary compartments except elapsed time meters, ammeters, switches, and pilot lights which shall be flush mounted in the appropriate cubicle with the devices labeled.

E. A continuous tin-plated copper ground bus bar at least 1/4 inch x 2 inches in size shall be provided in a conveniently accessible location. The ground bus shall be provided with solderless lugs for No. 2/0 AWG to No. 4/0 AWG cable for attachment to the ground grid as indicated on the Drawings.

F. Doors and access panels shall be flanged with the corners welded and ground smooth. Sheet metal for each panel shall be not less than .056 inch thick when the panel is not larger than 360 square inches; .067 inch thick when the panel is not larger than 1,000 square inches; and .097 inch thick when the panel is larger than 1,000 inches square. Access panels shall have one fastening device not more than six inches from each of the four corners and fastening devices not

more than 24 inches apart along vertical side. Any panel having dimensions not exceeding six inches high may be fastened by two fastening devices, one at the center of each of two opposite sides. Doors shall be secured with not less than two hinges. Hinges shall be located not more than four inches from each end of a door and shall be spaced not more than 24 inches apart. Each leaf of each hinge shall be fastened at not less than two points to the door, and not less than two points to the structure. Each hinged door shall be capable of supporting not less than four times its own weight and not less than thirty pounds without causing permanent deformation to the hinges. Doors shall be provided with snap latches or captive screws. Doors more than 48 inches long shall be fastened with a two point or three-point latch.

- G. Each vertical section shall be furnished complete with a 3-phase main horizontal bus. Power shall be distributed to units in the vertical sections by means of a 3-phase vertical bus. Buses shall be silver plated at all contact points or tin plated on aluminum bus. Bus supports shall be high dielectric strength, with low moisture absorption. All bus work shall be suitably braced to withstand short circuit currents as specified. A full height insulating barrier shall be provided for isolation of the vertical bus from the units. Guide rails or other means shall be provided in the structure for supporting and aligning starter units during removal or replacement. All units shall be easily removable and shall be connected to the vertical bus by means of self-aligning stab on bus connectors of low resistance arranged for positive contact with both sides of the bus at all times or by bolting on the larger sizes. A horizontal wiring and bus compartment shall be provided at the top and bottom. In addition, each section shall have a vertical wiring space equipped with cable tie supports for unit wiring. Bus bars shall be sized such that their temperature rise does not exceed 50 deg. C.

H. Solid State Motor Controllers - SMC (Electronic Soft Starter)

- 1. Manufacturer/Model:
 - a. Allen Bradley SMC Flex with external bypass contactor and options specified
 - b. Cutler Hammer, General Electric, Siemens, or Square D equal.
- 2. Features
 - a. Solid state motor controller for starting and stopping motor by accelerating and decelerating from 0%-100% of rated speed over an adjustable period.
 - b. Constructed within motor control center enclosure or separately mounted enclosure as indicated on the Drawings. Soft starter system shall be provided to permit continuous operation at rated current in an ambient temperature of 100 degrees F, while maintaining enclosure temperature below manufacturer's published operating temperature limit. Soft starter enclosures shall be provided with enclosure cooling fan(s) as required for adequate

cooling to meet ambient temperature requirements. If cooling fans are not required, manufacturer shall state so with the submittals. If enclosure cooling fans are required, they shall be fully integrated into the enclosure at the factory.

c. Assembly shall bear the U.L. label.

d. Electronic soft starter shall have the following features:

- 1) Adjustable starting ramp speed from 2 to 30 seconds.
Adjustable stopping ramp speed from 2 to 120 seconds.
- 2) Selectable ramp speed from 2 to 120 seconds.
- 3) Rated for motor full load current, continuous duty at nominal voltage, +/-10%. Rated for 300% duty for 30 seconds, minimum.
- 4) Adjustable startup torque from 5% to 90% of locked rotor torque.
- 5) Monitor motor overload auxiliary contacts and shut down motor if overload circuit opens.
- 6) Furnish with line side circuit breaker, internal automatic bypass contactor which bypasses the power electronics once the soft starter is up to speed and other components and features as indicated on the Drawings.
- 7) Furnish control power transformer internal to the starter enclosure to supply control power to the soft starter and soft starter enclosure auxiliaries (fans, indicating lights, relays, etc.). Size the control power transformer to handle the connected load with 50% spare capacity, minimum.
- 8) Furnish soft starter with auxiliary single pole, double throw, "Running" (up to speed) and "In Bypass" contacts rated 4 amps at 120VAC, minimum.
- 9) Line side SCR protective fuses and metal-oxide varistor (MOV) surge protection on incoming line terminals. Surge protection rated 80 joules, minimum.
- 10) Dielectric withstand:
 - (a) 2 kV continuous, line to ground
 - (b) 3 kV surge (10 seconds maximum) per IEEE Standard 472
- 11) Front door mounted microprocessor based operator interface unit with digital programming panel. Panel shall have programming keys and alphanumeric display to allow operator to view and modify drive parameters, alarms and operating conditions.
- 12) Programmable parameters (minimum):
 - (a) Starting mode
 - (b) Ramp time

- (c) Initial torque
 - (d) Current limit level
 - (e) Stall delay
 - (f) Energy saver
 - (g) Restart attempts
 - (h) Overload protection (confirm motor full load rating with motor manufacturer and program accordingly)
 - (i) Displays:
 - (1) Volts (A-B, B-C, C-A)
 - (2) Current (Phase A, B, C)
 - (3) Wattmeter
 - (4) Kilowatt hours
 - (5) Elapsed time'
 - (6) Power factor
 - (j) Protective features:
 - (1) Power loss
 - (2) Line fault
 - (3) Voltage unbalance
 - (4) Phase reversal
 - (5) Undervoltage
 - (6) Overvoltage
 - (7) Overload
 - (8) Stall
 - (9) Jam
 - (10) Underload
 - (11) Open gate
 - (12) Excess starts per hour
 - (13) Controller temperature
 - (14) Communication fault
 - (15) System faults
 - (16) MPU fault
- 13) Furnish each soft starter provided for pump applications with manufacturer's "Pump Control Module" for enhanced hydraulic cushioning benefit.
- 14) Front Panel Components and Control Configuration:
- (a) Six digit, non-resettable running time meter.
 - (b) Operator interface keypad/display unit.
 - (c) SPDT auxiliary contacts for remote monitoring as follows:
 - (1) Running (at full speed)
 - (2) Alarm/fault (any alarm condition)
 - (3) In Bypass
- 15) Ethernet Communication Port

- (a) Provide each electronic soft starter with Modbus TCP communication capability.

16) See Section 26 29 13 - Enclosed Controllers for details.

I. Branch Circuit Protection

1. Branch circuits served by motor control centers for devices other than motors shall use circuit breakers or fused switches as required.
2. Circuit breakers shall include both instantaneous and long time trip elements.
3. Circuit breakers shall have an interrupting rating equal to the bracing of the bus bars unless indicated otherwise.
4. Fused switches shall include dual element fuses with a rating as required for the application. Fuses shall be manufactured by Buss, Littelfuse, or equal.

J. Control Relays

1. Control Relays shall be quiet in operation and shall not have less than four contacts. Relays shall be enclosed in NEMA 1 enclosures and shall be mounted such that they may be removed and installed from the front. Installations where the bus bar compartment must be opened to remove nuts, etc., from mounting screws is not acceptable. Relay operating coils, contacts, etc., shall be designed for continuous operation in atmospheres up to 65 deg. C. Control relay compartments shall be convection cooled. Forced air cooling is not acceptable.
2. General control relays shall be plugin type with sockets. The relays shall have dust covers, suitable for continuous operation, and shall be rated for not less than 10 amps at 120 VAC, 1.0 PF. The contacts shall be 3/16" diameter silver cadmium oxide, min.

K. Elapsed time meters shall have a minimum of 5 digits and shall read in hours and tenths of hours. Meters shall be nominal 3" diameter with 1/8" high numerals.

L. Nameplates shall be supplied to identify each motor control center compartment and shall be of the laminated black and white composition type with black face and with engraving extending into the white to give white letters on a black background. Nameplates shall be 3 inches long by 1 inch high with 1/8-inch-high lettering. Nameplate for switches, relays and other accessories shall have 1/8-inch-high lettering and shall be sized as required. Nameplates shall be fastened with screws; adhesives only are not acceptable.

M. All control devices including, but not limited to, selector switches, pushbutton switches, limit switches and indicating lights shall be of the 30mm heavy duty, oil tight type. The contacts shall meet NEMA rating designation A600. All time clocks, timers, switches, relays, etc., shall be permanently labeled.

- N. Control wiring shall be copper, 90 deg C minimum and shall not be smaller than #14 AWG. All wiring for external connection shall be terminated on fabricated terminal blocks with lettering strips. All termination strips shall correspond with points called out on shop drawings and field connection diagrams.
- O. Surge Protection
 - 1. Provide a SPD in the MCC where indicated on the drawings. SPD shall meet requirements as specified Section 26 43 00 - Surge Protective Devices.
- P. Variable Frequency Drives (VFDs) and VFD Output Circuitry Requirements
 - 1. All VFDs are standalone enclosures, external to the MCC. See Section 26 29 23 - Variable Frequency Motor Controllers for additional information.
- Q. Equipment Schedule
 - 1. Motor Control Center SW57-MCC1
- R. CONTROL DEVICES
 - 1. Where required the Contractor shall supply all control devices including, but not limited to, selector switches, push button switches, limit switches, and indicating lights. All control devices shall be of the heavy duty, oil tight type. The contacts shall meet NEMA rating designation A600. Each control device shall be supplied complete with escutcheon and nameplate. Each control device shall have its function permanently marked on the escutcheon. Raised letters on plastic adhesive tape is not acceptable.
 - 2. Furnish and install engraved plastic type label designating equipment served. Embossed raised letter type labels shall not be acceptable. Letters shall be ¼" high and white in color on a black background.
- S. POWER FACTOR CORRECTION CAPACITORS
 - 1. Capacitor cells shall be of industrial grade that meet NEMA CP-1 standards. The capacitors shall not contain any PCBs or other environmentally damaging material. Capacitors shall not be internally fused.
 - 2. Accessories shall include current limiting, fast acting fuses with 100,000 A.I.C. fuses in each of the three phase legs with neon or LED lamps across the fuses. The fuses shall be removable from outside the capacitor enclosure. The disconnecting device shall open all phases simultaneously. The capacitor shall contain closed delta discharge resistors per NEC rules and shall contain 180 deg C wiring. The neon or LED lamps shall be visible without opening the capacitor compartments.

3. Capacitor enclosures shall be suitable to contain any liquid that escapes as a result of ruptures or leaks. The capacitor shall be fitted with a nameplate stating voltage, kVAR, capacity, phases and type of combustible material in addition to safety information, etc.
4. Capacitor sizes shown on the Drawings reflect the best information available at the time of the design. The Contractor shall confirm the capacitors identified with nameplate data and manufacturer's application data for the motors actually provided with the equipment.
5. Results shall be tabulated and submitted to the Engineer with the record drawings.
6. Required sizes shall be communicated to the manufacturer of the electrical equipment to permit furnishing of the capacitor sizes recommended by the motor manufacturers.
7. Source Quality Control Test Reports: Include reports for tests designated in IEEE 18 as design and routine tests.
8. Motor Overload Protective Device Calculations: Where capacitors are to be connected on the load side of motor overload protective devices (when permitted), indicate overload device ratings adjusted for reduced current.
9. Features:
 - a. Operating Characteristics: -40 - 115 Deg. F
 - b. Altitude: Contractor to confirm any derating required, values shown on the Plans/Addendum do not incorporate derating.
 - c. UL 810 listed
 - d. Safety Features: Internal Discharge Resistors, exterior disconnect, pressure sensitive interrupter
 - 1) Discharge Resistors: Provide discharge resistors as required to reduce residual voltage to less than 50 V within one minute after capacitor is disconnected from source of supply in accordance with NFPA 70.
 - e. Enclosure: NEMA 1, note to be mounted inside Soft Starter Enclosure
 - f. Losses: Not greater than 0.5 W per kVAR.
 - g. Rated Life: 20 years.
 - h. Contactors: Suitable for high inrush currents associated with capacitor switching.
10. Manufacturer:
 - a. Eaton
 - b. GE
 - c. Square D
 - d. ABB
 - e. Approved Equal

T. Manufacturers:

1. Allen Bradley
2. Cutler Hammer
3. Square-D
4. ABB
5. Prior approved equal

PART 3 EXECUTION

3.01 INSTALLATION

- A. Concrete housekeeping pad provided by Electrical Contractor. Concrete pad shall be as noted on the Drawings. Pad shall be provided so that circuit breaker operating handles do not exceed the N.E.C. allowed maximum operating height.
- B. Examine area to receive motor control center to assure adequate clearance for installation.
- C. Check that concrete pads are level and free of irregularities.
- D. Verify exact dimensions with supplier prior to conduit rough-in.
- E. Install motor control center in accordance with manufacturer's instruction.
- F. Field test prior to energization:
 1. Megger checks of phase to phase and phase to ground insulation levels.
 2. Continuity.
 3. Short circuit.
- G. Perform tests according to manufacturer's instruction.
- H. Provide all starters (except spare units) with overload element equal to the nameplate rating on the installed motor.
- I. Adjust operating mechanisms for free mechanical movement.
- J. Tighten bus connections and mechanical fasteners.
- K. Touchup scratched or marred surfaces to match original finish.

3.02 CAPACITOR SIZING

- A. Capacitor sizes shown on the Drawings reflect the best information available at the time of the design. The Contractor shall confirm the capacitors identified with nameplate data and manufacturer's application data for the motors actually provided with the equipment. Contractor shall confirm any derating required due to altitude or any other site condition that will reduce the capacitor performance. In general the Plans and Specs do not take derating into account unless noted otherwise.
- B. Note sizes shown on the Plans or in the Specs may not correspond with manufacturers standard offerings. If this is the case, the Contractor shall select

the next larger size, but shall confirm that the additional capacitance will not cause the motor system to reach unity power factor, or leading power factor.

- C. Results shall be tabulated and submitted to the Engineer with the record drawings.
- D. Required sizes shall be communicated to the manufacturer of the electrical equipment to permit furnishing of the capacitor sizes recommended by the motor manufacturers.

3.03 TRAINING

- A. Training on the motor control center(s), soft starter and related equipment shall be for four (4) hours, minimum. Training shall consist of two (2) separate 2-hour sessions at the Site.
- B. All training sessions shall be at times prior approved by the Owner. Two weeks prior notice shall be given in writing for all training sessions.

3.04 SUPPLIES

- A. At Final Completion, Contractor shall furnish the following expendable items:
 - 1. Five (5) percent spare fuses and lamps of each type furnished under this Section, but not less than two (2) of each type.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish and install all wiring devices and device plates where shown on the Drawings.

B. Related Work:

1. Section 26 05 37 - Boxes

1.02 WORK INSTALLED BUT FURNISHED BY OTHERS

- A. Where indicated, install devices supplied by Division 1 through 40.

1.03 QUALITY ASSURANCE

A. NEMA

B. U.L. Listed

C. NFPA 70 - National Electrical Code, current adopted Edition

1.04 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit in accordance with Specification Section 01 33 00 - Submittal Procedures. Clearly indicate device type, voltage, amperage, NEMA configuration, color.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store in a dry area, protected from the weather.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit in accordance with Specification Section 01 78 23 - Operation and Maintenance Data, a list of all devices used, including manufacturer and type.

PART 2 PRODUCTS

2.01 DUPLEX RECEPTACLES: (SURFACE MOUNTED IN FINISHED AREAS)

- A. Manufacturer: Equal to Hubbell #5352 Series, Bryant #5352, Leviton #5352, P&S CR Series, or P&S #5362 Series duplex.

B. Type:

1. Specification grade

2. Gray in color (normal applications); Blue for UPS applications.
3. 20 Ampere
4. 120 Volt
5. 3 Wire Grounding

2.02 GROUND FAULT RECEPTACLE

- A. Manufacturer: P&S 1597 Series, Eaton SGF15, Leviton:
 1. 15 A Capacity
 2. Gray
 3. 120 Volt with 5 milliampere trip
- B. Manufacturer: P&S 2097 Series, Eaton SGF20, Leviton:
 1. 20 A Capacity
 2. Gray
 3. 120 Volt with 5 milliampere trip
- C. Other Manufacturers and models must be approved by Engineer

2.03 TOGGLE SWITCHES

- A. Manufacturer: Equal to P & S #20AC, Eagle 2221
- B. Type:
 1. Specification grade
 2. Gray in color
 3. 20 Ampere
 4. 120/277 Volt
 5. Quiet operation, keyed switch where indicated, single pole unless noted otherwise.

2.04 PILOT LIGHTED SWITCHES

- A. Manufacturer: Equal to P & S #20AC1-RPL, Eagle 2221PL
- B. Type:
 1. Red in color
 2. 20 Ampere
 3. 120/277 Volt
 4. Quiet operation
- C. Neon type that is illuminated when switch is in the "on" position
- D. Specification grade

2.05 PILOT LIGHTS

- A. Manufacturer: Equal to Arrow Hart

- B. Type:
 - 1. Neon with red jewel

2.06 DEVICE PLATES

- A. Provide device wall plates per Specification Section 26 05 37 - Boxes and as required by NEC.

2.07 WEATHERPROOF COVERS

- A. Provide weatherproof device covers on all exterior devices, wet area devices, chemical room devices and in other areas indicated on the Drawings and as required by the NEC.
- B. Unless indicated otherwise, covers shall be of the "weather protected while in use" variety and shall consist of the following:
 - 1. Exterior Applications: cast aluminum, lockable, sized as required for the application. Manufacturer/Model: Intermatic / Type #WP10, or equal.
 - 2. Wet, Chemical or Caustic Interior Areas: clear plastic or PVC construction, Carlon, Intermatic WP5100 Series, or equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install devices and device plates where shown on the Drawings.
- B. All receptacles and switches listed within this section shall be installed with the ground side down.
- C. Provide blank plates for unused openings.
- D. See Section 26 05 53 - Identification for Electrical Systems for engraving requirements for pilot lights and pilot lighted switches.

3.02 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, and other foreign material and restore to match original factory finish.

3.03 PROTECTION

- A. Protect installed products from subsequent construction operations.

END OF SECTION

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SECTION 26 28 13

FUSES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Furnish and install fuses for all fuse holders in equipment provided by Division 26 except where equipment is noted "spare".
- B. Related Work:
 - 1. Section 26 24 19 - Motor Control Centers
 - 2. Section 26 28 18 - Enclosed Switches
 - 3. Section 26 29 23 - Variable Frequency Motor Controllers

1.02 WORK FURNISHED BUT NOT INSTALLED

- A. Supply to the Owner one spare fuse for each fuse installed of 400 ampere or larger rating.
- B. Supply to the Owner, below 400 ampere, one spare fuse for each three fuses of each ampere and class rating installed with a minimum of three spares for each ampere rating and class rating used.

1.03 QUALITY ASSURANCE

- A. U.L. listed.

1.04 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit in accordance with Specification Section 01 33 00 - Submittal Procedures.
- B. Clearly indicate fuse class, voltage, fuse curves, amperage.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store in a dry area, protected from the weather.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit data in accordance with Specification Section 01 78 23 - Operation and Maintenance Data for fuse characteristics and list of fuse types and manufacturer.

PART 2 PRODUCTS

2.01 FUSES

- A. Manufacturer: Bussman Manufacturing, Gould/Shawmut or equal.
 - 1. Type:
 - a. 600 amperes and larger; Class L; Buss KRP-C or Gould A4BQ.
 - 2. Type
 - a. Less than 600 amperes; Class J; Buss LPJ or Gould AJT
 - 3. Type
 - a. Motor branch circuit protection, less than 600 amperes; Class J, with time delay characteristics; Buss LPJ or Gould AJT

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide fuses for all fuse holders in equipment furnished by Division 26.
- B. Install fuses with label oriented outward such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 28 18
ENCLOSED SWITCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnish and install disconnects for motors and equipment as required by National Electrical Code, for personnel protection and for electrical isolation of equipment.

1.02 QUALITY ASSURANCE

- A. U.L. Listed, heavy duty type.

1.03 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit in accordance with Specification Section 01 33 00 - Submittal Procedures.
- B. Clearly indicate voltage, amperage, quantity of poles, dimensions, fuse clip type, horsepower rating, enclosure type, handle description, required clearances.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Store in a dry area, protected from the weather.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's instructions in accordance with Specification Section 01 78 23 - Operation and Maintenance Data for maintenance including cleaning, tightening conductor connections, fuse replacement data and renewal parts list.

PART 2 PRODUCTS

2.01 DISCONNECTS

A. General Requirements

1. Heavy duty type, horsepower rated
2. Quick make, quick break operation
3. Non fused, unless noted fused on the Drawings.
4. 250 VAC or 600 VAC as required per the load they serve.

B. Type

1. NEMA 12 for disconnects located in controlled atmosphere, general areas of the facility, unless indicated otherwise on the Drawings. NEMA 12 shall be considered the default enclosure rating for interior disconnects in non-

caustic, wet or corrosive areas of the facility, unless indicated otherwise on the Drawings.

2. NEMA 4X for disconnects located in wet, caustic or corrosive areas, unless indicated otherwise on the Drawings. The disconnects shall be stainless steel or non-metallic as defined on the Drawings.
3. NEMA 3R for disconnects located outside building or subject to damp or wet areas, unless specifically noted otherwise on the Drawings.
4. Where indicated on the Drawings, provide disconnect switches used on VFD outputs with an auxiliary contact that opens prior to the respective "phase" contacts. The auxiliary contact shall be wired to the respective "enable input" of the VFD to shut down and disable the VFD prior to the phase conductor's opening.

C. Manufacturer

1. Square-D
2. Cutler Hammer
3. Siemens
4. General Electric

PART 3 EXECUTION

3.01 INSTALLATION

- A. Securely mount safety switches plumb and level.
- B. Comply with accessibility, clearance and mounting height requirements as listed in the National Electrical Code.
- C. Tighten all conductor connections according to manufacturer's recommendations.

3.02 CLEANING

- A. Clean dirt and debris from switch enclosure and components according to manufacturer's instruction.
- B. Repair scratched or damaged exterior surface to original factory finish.

END OF SECTION

SECTION 26 29 13
ENCLOSED CONTROLLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Motor starters for all motors shall be furnished and installed within the MCC or their respective control panel by Division 26, unless noted otherwise on the Schedules included with the Drawings.
 - a. Separately mounted motor starters shall be provided where indicated on the Schedules included with the Drawings.

B. Related Work:

1. Section 26 05 34 - Conduit
2. Section 26 05 19 - Power and Instrumentation Cable - Less Than 600V
3. Section 26 24 19 - Motor Control Centers

1.02 QUALITY ASSURANCE

A. NEMA U.L. listed

1.03 WORK FURNISHED AND INSTALLED BY OTHERS

A. Motors are provided by other Specifications Sections.

1.04 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit in accordance with Specification Section 01 33 00 - Submittal Procedures.
- B. Clearly indicate motor starter size, dimensions, schematic wiring diagrams, and accessories.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's data in accordance with Specification Section 01 78 23 - Operation and Maintenance Data for operation and maintenance data for repairing, cleaning, testing requirements and parts list.

PART 2 PRODUCTS

2.01 MOTOR STARTERS

- A. Solid State Motor Controllers - SMC (Electronic Soft Starter)

1. Manufacturer/Model: Allen Bradley SMC Flex with internal bypass contactor and options specified or equivalent Cutler Hammer, General Electric, Siemens, or Square D product.
2. Features
 - a. Solid state motor controller for starting and stopping motor by accelerating and decelerating from 0%-100% of rated speed over an adjustable period.
 - b. Constructed within motor control center enclosure as indicated on the Drawings. Soft starter system shall be provided to permit continuous operation at rated current in an ambient temperature of 100 degrees F, while maintaining enclosure temperature below manufacturer's published operating temperature limit. Soft starter enclosures shall be provided with enclosure cooling fan(s) as required for adequate cooling to meet ambient temperature requirements. If cooling fans are not required, manufacturer shall state so with the submittals. If enclosure cooling fans are required, they shall be fully integrated into the enclosure at the factory.
 - c. Assembly shall bear the U.L. label.
 - d. Electronic soft starter shall have the following features:
 - 1) Adjustable starting ramp speed from 2 to 30 seconds.
Adjustable stopping ramp speed from 2 to 120 seconds.
 - 2) Selectable ramp speed from 2 to 120 seconds.
 - 3) Rated for motor full load current, continuous duty at nominal voltage, +/-10%. Rated for 300% duty for 30 seconds, minimum.
 - 4) Adjustable startup torque from 5% to 90% of locked rotor torque.
 - 5) Monitor motor overload auxiliary contacts and shut down motor if overload circuit opens.
 - 6) Furnish with line side circuit breaker, external isolation contactor, and external automatic bypass contactor which bypasses the power electronics once the soft starter is up to speed and other components and features as indicated on the Drawings.
 - 7) Furnish control power transformer internal to the starter enclosure to supply control power to the soft starter and soft starter enclosure auxiliaries (fans, indicating lights, relays, etc.). Size the control power transformer to handle the connected load with 50% spare capacity, minimum.
 - 8) Furnish soft starter with auxiliary single pole, double throw, "Running" (up to speed) and "In Bypass" contacts rated 4 amps at 120VAC, minimum.

- 9) Line side SCR protective fuses and metal-oxide varistor (MOV) surge protection on incoming line terminals. Surge protection rated 80 joules, minimum.
- 10) Dielectric withstand:
 - (a) 2 kV continuous, line to ground
 - (b) 3 kV surge (10 seconds maximum) per IEEE Standard 472
- 11) Front door mounted microprocessor based operator interface unit with digital programming panel. Panel shall have programming keys and alphanumeric display to allow operator to view and modify drive parameters, alarms and operating conditions.
- 12) Programmable parameters (minimum):
 - (a) Starting mode
 - (b) Ramp time
 - (c) Initial torque
 - (d) Current limit level
 - (e) Stall delay
 - (f) Energy saver
 - (g) Restart attempts
 - (h) Overload protection (confirm motor full load rating with motor manufacturer and program accordingly)
 - (i) Displays:
 - (1) Volts (A-B, B-C, C-A)
 - (2) Current (Phase A, B, C)
 - (3) Wattmeter
 - (4) Kilowatt hours
 - (5) Elapsed time'
 - (6) Power factor
 - (j) Protective features:
 - (1) Power loss
 - (2) Line fault
 - (3) Voltage unbalance
 - (4) Phase reversal
 - (5) Undervoltage
 - (6) Overvoltage
 - (7) Overload
 - (8) Stall
 - (9) Jam
 - (10) Underload
 - (11) Open gate
 - (12) Excess starts per hour
 - (13) Controller temperature

- (14) Communication fault
 - (15) System faults
 - (16) MPU fault
- 13) Furnish each soft starter provided for pump applications with manufacturer's "Pump Control Module" for enhanced hydraulic cushioning benefit.
- 14) Front Panel Components and Control Configuration:
 - (a) Six digit, non-resettable running time meter.
 - (b) Operator interface keypad/display unit.
 - (c) SPDT auxiliary contacts for remote monitoring as follows:
 - (1) Running (at full speed)
 - (2) Alarm/fault (any alarm condition)
 - (3) In Bypass
- 15) MCC manufacturer to provide 20A/1P circuit breaker and load-rated interposing relay to within RVSS section to energize motor condensation heater when the motor is off and de-energize the heater when the motor is running.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All starters shall be installed within the project MCC(s), unless noted otherwise on Drawings.
- B. Provide all starters with overload elements or overload relay setting ranges equal to or greater than the nameplate rating on the installed motor.
- C. Terminate all motor lead connections.
- D. Coordinate and provide all interconnects between MCC starters, and all control panels. Provide complete labeled wiring diagram showing all connections.

3.02 SUPPLIES AND SPARE PARTS

- A. At Final Completion, Contractor shall furnish the following expendable items:
 - 1. Complete set of overload heater elements of each size installed, or if electronic overload relays are utilized, provide a spare electronic overload relay of each size installed.

END OF SECTION

SECTION 26 29 23
VARIABLE FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. **The site elevation is approximately 4950 feet above sea level. All equipment as noted within the Contract Documents shall carry a rating as indicated at this noted site elevation. The equipment manufacturers shall be responsible for applying all necessary altitude de-rating factors.**
2. Furnish and install adjustable frequency drive controllers (VFDs) for all motors as shown on the Drawings.
3. Supply of VFDs in the following applications as indicated on the Drawings:
 - a. "Clean Power" VFDs"
 - 1) "Clean Power" VFDs shall utilize one of the input circuitry types listed below:
 - (a) 18-pulse rectifiers, 18-pulse rectifiers shall be of the type with autotransformer frontends.
 - (b) 6 pulse rectifiers with integral incoming harmonic filter as specified below.
 - (c) Active Front End (AFE) with inhibited regenerative characteristics.
4. Provide local control devices as indicated on the Drawings.
5. Provide VFD output dV/dT filters as indicated on the Drawings.
6. Provide incoming harmonic filters as indicated on the Drawings.
7. Provide local disconnect switches with auxiliary contact as indicated on the Drawings.
8. It is the intent of this Specification that the project VFDs be provided with Type II-B wiring diagrams and fully integrated into the project control system by the Contractor.

B. Related Work:

1. Section 26 05 10 - Motors
2. Section 26 05 19 - Power and Instrumentation Cable - Less Than 600V
3. Section 26 05 34 - Conduit
4. Section 26 24 19 - Motor Control Centers

1.02 QUALITY ASSURANCE

A. National Fire Protection Association (NFPA)

1. NFPA 70 National Electrical Code (NEC), current adopted Edition
 - B. National Electrical Manufacturer's Association (NEMA)
 1. NEMA ICS 1 - General Standards for Industrial Control and Systems
 2. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies
 3. NEMA 250 - Enclosures for Electrical Equipment
 4. NEMA CP-1 - Capacitors
- 1.03 WORK FURNISHED AND INSTALLED BY OTHERS
- A. All motors provided by other Specification Sections should meet the requirements of Section 26 05 10 - Motors.
 - B. VFDs shall be integrated into the control system and provided with Type II-B control drawings by the Contractor.
- 1.04 SHOP DRAWINGS AND PRODUCT DATA
- A. Submit in accordance with Section 01 33 00 - Submittal Procedures. Clearly indicate VFD nameplate ratings, dimensions, schematic wiring diagrams, accessories.
- 1.05 OPERATION AND MAINTENANCE DATA
- A. Submit manufacturer's data in accordance with Section 01 78 23 - Operation and Maintenance Data for operation and maintenance data for repairing, cleaning, testing requirements and parts list.
 - B. Include a VFD setting sheet that lists the final settings of each VFD as coordinated with the equipment supplier(s).

PART 2 PRODUCTS

2.01 VARIABLE FREQUENCY DRIVES

- A. Variable frequency drive (VFD) unit shall be pulse width modulated (PWM) type incorporating volts per Hertz control. Unit shall bear the U.L. label. Refer to the Drawings for specific details.
- B. Input characteristics and requirements:
 1. 480 volt (nominal) +/- 10%, three phase, 60 Hz +/- 1.0 Hz.
 2. Efficiency, 97.0% at full speed, input to output; input line pf, 0.95 minimum.
 3. Drive shall automatically shut down on input power abnormalities and shall automatically restart upon restoration of "normal" power.
 4. Incoming line surge protection, arresters, and surge capacitors shall be provided at a minimum.
 5. 18-pulse VFD Input Equipment Requirements

- a. VFD input circuitry (each VFD) shall include 18 pulse rectifiers shall be provided as indicated on the Drawings. 18-pulse rectifiers, where indicated, shall be of the type with autotransformer frontends.
- 6. Active Front End Drive Input Equipment Requirements
 - a. LCL input filters shall be installed ahead of input IGBTs where noted on plans.
- C. Ambient conditions:
 - 1. Temperature: 0-40°C.
 - 2. Humidity: 5-95% non-condensing.
- D. Output conditions:
 - 1. 480 volt, 3 phase.
 - 2. Rated for 110% of drive amperage rating overload for one minute, minimum.
 - 3. Variable Torque – Standard duty VFD applications such as centrifugal fans and pumps shall be provided with variable torque VFD ratings.
 - 4. Constant Torque - Heavy duty VFD applications such as augers, rotary lobe pumps, mixers, etc. shall be provided with constant torque VFD ratings. See the Drawings for additional information.
- E. Features:
 - 1. VFD's for installation within waste water facilities or lift stations, harsh environments, or areas exposed to chemical exposure shall have circuit boards conformally coated for increased corrosion resistance protection.
 - 2. Front door mounted microprocessor based unit with digital programming panel. Panel shall have programming keys and alphanumeric display to allow operator to view and modify drive parameters, alarms, and operating conditions.
 - 3. Programmable parameters:
 - a. Acceleration time
 - b. Deceleration time
 - c. Frequency range
 - d. Skip frequency ranges
 - e. Number of restart attempts
 - 4. Overload protection (Confirm full load rating w/motor manufacturer and program VFD to limit speed such that motor is not overloaded.)
 - 5. Programmable displays:
 - a. Frequency
 - b. Voltage
 - c. Percent load
 - d. Percent power

6. Protection features (with separate indications for each event):
 - a. Undervoltage trip
 - b. Overvoltage trip
 - c. Drive overcurrent trip
 - d. Drive overtemp trip
 - e. Motor overcurrent trip
 - f. Motor overtemp trip (monitor normally closed thermal switch in motor)
 - g. Output ground fault trip
- F. Front Panel Components and Control Configuration:
 1. Six digit, non-resettable running time meter. Record running time in hours and tenths.
 2. Speed potentiometer shall be used to control the speed of the drive while the selector switch is in "Hand".
 3. Generate 4-20 mAdc isolated signal proportional with drive speed from 0 to 100%.
 4. Lockout/Disable - Where shown, prevent drive operation when remote contacts such as "motor overtemperature" or "local disconnect switch open" are open.
 5. Auxiliary Contacts - Provide isolated SPDT contacts for remote monitoring as indicated on the Drawings. Provide interposing relays within the VFD enclosure to provide the contacts as required. Contacts typically include, but are not limited to the following:
 - a. "Running" (two sets of SPDT contacts)
 - b. "Alarm/Fault" (any alarm condition)
 - c. "Motor Disabled (local disc sw open)"
 - d. "Motor Overtemp"
 - e. "HOA in AUTO Position"
 - f. Additional contacts as indicated on the Drawings.
 6. Ramp Up / Ramp Down Settings
 - a. Coordinate, confirm, and document all VFD settings including, but not limited to, ramp rate, minimum speed, and maximum speed with the process equipment supplier during startup. Field test and adjust all settings in cooperation with the process equipment supplier.
 - b. It is anticipated that each VFD will be set to ramp up to a pre-determined speed set at the VFD over an adjustable time period (20 seconds nominal - confirm).
 - c. It is anticipated that each VFD will ramp down upon stop command over an adjustable time period (20 seconds nominal - confirm). On pumps, the VFD should stop at approximately the same time that the pump check valve closes - if applicable. Adjust

this feature to approximate time required to minimize water hammer.

- d. Coordinate exact requirements with individual equipment suppliers and program specialty ramps (such as dual slope ramps to submersible well motors to protect the Kingsbury bearings) as required to maintain equipment warranty.
7. Ethernet Control Module - Able to see and modify drive parameters as listed on the drawings over Modbus TCP/IP network via the manufacturers Ethernet communications card.
8. All control devices including, but not limited to, selector switches, pushbutton switches, limit switches and indicating lights shall be of the 30mm heavy duty, oil tight type. The contacts shall meet NEMA rating designation A600. All time clocks, timers, switches, relays, etc., shall be permanently labeled.
9. Front Panel Push-to-Test Indicating Lights – Provide push-to-test indicating lights with LED lamps as follows:
 - a. Green - "Running"
 - b. Red - "Alarm/Fault"
 - c. Amber - "High Temp" (Motor Thermal)
10. Front panel selector switch shall have the following functions:
 - a. "Hand" (Speed Select 1) - Start up and run based on the speed potentiometer.
 - 1) "Off" - Drive does not operate under any condition.
 - 2) "Auto" (Speed Select 2) - Drive runs when remote "required" contacts are closed. Drive speed shall be based on a 4-20 mA speed signal from the PLC.

G. Enclosure

H. Manufacturer/Model

All project drives furnished shall be provided from the same manufacturer

1. AllenBradley Powerflex
2. Square D equivalent
3. Cutler Hammer equivalent
4. ABB
5. Or prior approved equivalent.

2.02 VFD OUTPUT FILTERING

- A. Furnish and install motor dv/dt filter for use on motor cable runs exceeding 50 feet for motors with a peak voltage insulation rating less than 1600 Vac or as indicated on the drawings.
- B. It is the Contractor's responsibility to appropriately size the dV/dT filters for the connected load. The continuous ampere rating of the dV/dT filter shall be equal

to or greater than the full load ampere output rating of the associated VFD at the given site elevation.

- C. dV/dT filters shall be installed in UL listed, NEMA 12 enclosures if provided outside the overall VFD enclosure and shall be the responsibility of the Contractor to install and completely connect with cable and conduit at no additional cost to the Owner. The preferred method of dV/dT filter supply is for them to be provided as an integral part of the overall VFD system (internal to the overall VFD enclosure). Overall assembly shall be UL listed to UL-508A.
- D. Manufacturer/Model:
 - 1. MTE / Series A dV/dT Filter
 - 2. TCI Equal
 - 3. Or prior approved equivalent

2.03 INCOMING HARMONIC FLITERS

- A. The harmonic filter shall treat all characteristic low frequency harmonics generator by a 3 phase full wave converter load (5th, 7th, 11th, 13th, etc.)
- B. The harmonic filter shall be a passive series connected low pass filter consisting of an inductor capacitor network.
- C. The harmonic filter shall be capable of feeding a rectifier composed of diodes, thyristors, or any combination thereof.
- D. The harmonic filter shall meet the harmonic performance specifications with a 3% phase voltage unbalance as defined by ANSI C-84.1-1995.
- E. The filter shall be UL-508 Listed.
- F. The harmonic filter in combination with the variable frequency drive shall meet the requirements of IEEE 519.
- G. The harmonic filter shall be configured such that it contains an isolation contactor which will automatically isolate the harmonic filter's power factor correction capacitors through the use of a current switch. Filter capacitors shall not be activated until the VFD is a minimum of 60% loaded.
- H. Manufacturer/Model:
 - 1. MTE Corp: Matrix AP series
 - 2. TCI Equal
 - 3. Or prior approved equivalent

2.04 CONTROL DEVICES

- A. Where required the Contractor shall supply all control devices including, but not limited to, selector switches, push button switches, limit switches, and indicating lights. All control devices shall be of the heavy duty, oil tight type. The contacts

shall meet NEMA rating designation A600. Each control device shall be supplied complete with escutcheon and nameplate. Each control device shall have its function permanently marked on the escutcheon. Raised letters on plastic adhesive tape is not acceptable.

- B. Furnish and install engraved plastic type label designating equipment served. Embossed raised letter type labels shall not be acceptable. Letters shall be ¼" high and white in color on a black background.
- C. Control Power Transformers (CPT) are to be installed within VFD enclosures as shown on drawings for use with control devices and accessories. CPT's are to be sized with 25% spare capacity minimum and provided with primary and secondary fused protection.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide all VFDs with variable torque or constant torque ratings as required for the driven equipment, continuous full load ampere ratings and overload settings equal to or greater than the nameplate rating on the installed motor.
- B. The Contractor (in conjunction with the process or mechanical equipment supplier and the VFD supplier) shall fully test and adjust the variable frequency drive to allow control of each system to maximum efficiency, including lockout frequencies. The final arrived at settings for each VFD system shall be submitted to the Engineer and included in the O&M manuals.

3.02 SUPPLIES

- A. At Final Completion, Contractor shall furnish the following expendable items:
 - 1. Twenty (20) percent spare fuses and lamps of each type furnished under this Section, but not less than two (2) of each type.
 - 2. The following spare parts shall be provided:
 - a. Main Control Board - One (1) per VFD Frame size on the project to which they are compatible with.
 - b. HIM - One (1) of each type provided on the project
 - c. Communication Card - One (1) per VFD Frame size to which they are compatible with.
 - d. Fans - One (1) per VFD Frame size provided on the project to which they are compatible with.
 - e. I/O Cards - One (1) of each type provided on the project.

END OF SECTION

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SECTION 26 32 13
ENGINE GENERATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. **The site elevation is approximately 4950 feet above sea level. All equipment as noted within the Contract Documents shall carry a rating as indicated at this noted site elevation. The equipment manufacturers shall be responsible for applying all necessary altitude de-rating factors.**
2. Furnish and install a complete engine generator set, fully assembled as indicated on the Drawings, tested and ready to operate including fuel supply, exhaust system and cooling equipment. This unit shall be installed at the JVWCD 5700 West and 10200 South Pump Station. Both engine and generator shall be the responsibility of a single manufacturer and be of a standard model or series in regular production at the manufacturer's place of business. No unit assembled by anyone other than a recognized manufacturer will be accepted.

GENERATOR SIZE (MINIMUM):	600 kW
GENERATOR EXCITATION:	PERMANANT MAGNET (PMG)
GENERATOR EMISSIONS TYPE:	STATIONARY EMERGENCY (TIER 3)
GENERATOR FUEL TYPE:	DIESEL
GENERATOR ENSLOSURE TYPE:	SKIN TIGHT
SOUND ATTENUATION:	LEVEL 3
GENERATOR MOUNTED BREAKER:	1200A/3P
GENERATOR LOAD BANK:	N/A

1.02 DESCRIPTION OF SYSTEM

- A. After failure of normal power, the engine starts automatically, attains rated voltage and frequency and in conjunction with the automatic transfer switch, transfers power to the load in less than 10 seconds from the time of the power failure signal. Upon restoration of utility power, automatically retransfer load back to normal power, and then shuts down the generator (after programmable cool down period) and returns to readiness for another operating cycle.
- B. Generator shall meet most current and adopted emissions standards in project location for an Emergency Standby application.

1.03 QUALITY ASSURANCE

- A. Built to NEMA Standards, U.L. 2200 listed (generator set), and in accordance with NFPA 70. The engine generator set will be a packaged unit and will be the product of a single manufacturer, with all warranties for the complete unit provided by the factory.

1.04 REQUIREMENTS OF REGULATORY AGENCIES

- A. The electric generating system consists of a prime mover, generator, governor, coupling and all controls.
- B. Conform to N.E.C. and applicable inspection authorities.

1.05 WARRANTY

- A. The manufacturer and dealer shall provide a warranty which shall be for a period of five (5) years (1500 operating hours) from date of initial startup of the system.
 - 1. The warranty shall include repair parts, labor, reasonable travel expense necessary for repairs at the jobsite, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during the course of repair.
 - 2. Applicable deductible costs shall be specified in the manufacturer's warranty.
 - 3. Submittals received without written warranties as specified will be rejected in their entirety.

1.06 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit in accordance with 01 33 00 - Submittal Procedures.
- B. Clearly indicate all connection points, installed weight, dimensions, clearance requirements, accessory description, fuel requirements, air quantity requirements, electrical rating, power factor, short circuit available amperes (R.M.S. value), voltage regulator type, temperature rise of the alternator, ambient air rating of the radiator, recommended pipe sizes and routing.
- C. **Indicate the site rated value for kW and kVA.**

1.07 DELIVERY, STORAGE AND HANDLING

- A. Generator Supplier shall deliver generator set (FOB) to the site, unload, and set directly onto the concrete pad.

1.08 OPERATION AND MAINTENANCE DATA

- A. Include complete data in accordance with Section 01 78 23 - Operation and Maintenance Data for maintaining and operating the unit including fuel requirements, lubrication requirements, exercising, tests to be performed, spare

parts list, troubleshooting guide, description of operation. Include a minimum of four (4) hours for Owner instruction.

1.09 MOTOR STARTING CAPABILITY

A. Motor Starting Capability

1. The engine generator set shall have sufficient starting kVA to withstand the loading sequence listed below. The staggered start sequencing indicated will be provided from combination of the ATS and plant PLC SCADA system programming, separate from generator system. During motor starting, instantaneous voltage dip shall not exceed the limits indicated per individual step. The Contractor shall submit calculations with the shop drawing submittal that confirm the unit's conformance with this requirement.

Starting Sequence:

- a. Step 1 Loads (15% Maximum Allowable Voltage and Frequency Dip per Step)
 - 1) 65kW Heating/AC Loads/Misc Load consisting of small horsepower motors, 5hp or less started across the line.
- b. Step 2 Loads (10% Maximum Allowable Voltage and Frequency Dip per Step)
 - 1) (1) 400 HP NEMA motor – started via electronic Soft Starter with 300% current limit.

1.10 SUPPLIER EXPERIENCE AND CAPABILITIES

- A. It is the intent of this Specification that all equipment specified in this Section shall be furnished by a single source supplier who shall assume system responsibility along with the Contractor.
- B. The engine generator set supplier shall be normally engaged in the assembly, installation, repair, and maintenance of generation equipment. The supplier shall have provided at least five (5) systems of equal or greater complexity/size in the last year.
- C. The supplier shall be a factory authorized sales, parts, and service representative of the engine manufacturing company. The supplier shall demonstrate that it has spare parts in stock to service and maintain the engine and to repair the unit in 48 hours or less for most failures.
- D. The supplier shall have a service depot within a 100 mile radius of the project site.
- E. The supplier shall modify or supplement the supplier's "standard products" to meet these specifications. Standard products of a particular supplier that do not

meet the functional and technical requirements of the specification are not acceptable.

- F. The supplier shall have qualified, trained service personnel on staff who are capable of maintaining and repairing the equipment. The supplier shall be capable of offering an extended service contract after completion of the warranty period, including 24 hour, 7 day per week emergency services.
- G. Upon request, the supplier shall submit:
 - 1. List of five (5) projects referenced above, including customer's name, contact person, and phone number.
 - 2. Description of service contract capability, including number of personnel, their location, and types of service contract available.

1.11 SITE REQUIREMENTS

A. Noise

- 1. The power generation system for this application shall meet the following noise requirements.
 - a. Noise from the generation equipment shall not exceed 70dB over background noise 25 feet from the enclosure in any direction with the unit operating at full standby load conditions.
 - b. Noise from the generation equipment shall meet all City and State requirements. General requirements are:

MAXIMUM ALLOWABLE NOISE LEVELS

Octave Band Frequency	Maximum Decibel Level
20-75	65
75-150	60
150-300	55
300-600	46
600-1200	40
1200-2400	34
2400-4800	31
4800 & over	28

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. The generator set shall be as manufactured by:
 - 1. Caterpillar
 - 2. Cummins N Power
 - 3. Prior approved equal

- B. The engine, generator and all major items must be manufactured in the United States.

2.02 RATINGS

- A. 277/480 VAC output voltage at 60Hz, 3 phase.
- B. 600 Standby eKW @ .8PF, 750 kVA
 1. The standby (maximum or intermittent) rating of the unit shall not exceed the fuel rate limit of the engine based on two (2) hours of standby operation out of any 24 hour period at rated speed and rated voltage. The ambient temperature is 120 degrees F. This is measured two (2) feet from the end bearing housing of the generator in line with the shaft. The standby rating shall be no greater than 10% above the prime rating. The rating must be adjusted for the elevation of the installation if necessary. The engine fuel rate must not be adjusted higher than the fuel rate recommended by the engine manufacturer.
 2. The submittal shall include the efficiency of a similar production generator and the fuel utilization of a similar production engine after 4 hours of continuous operation at prime rated load. This data shall be based on #2 diesel fuel with a cetane rating of 40.
 3. These ratings must be substantiated by the manufacturer's certified standard published curves. Special ratings or maximum ratings are not acceptable.
- C. Ambient temperature: -35 Degrees F. minimum to +120 Degrees F. maximum

2.03 ENGINE

- A. Type
 1. Diesel utilizing number 2 fuel
 2. Liquid cooled
 3. Four cycle
 4. 1800 RPM
 5. Full pressure lubrication system; engine driven lube oil pump
 6. Lube oil filters
 7. Spring loaded bypass valve
 8. Lube oil cooler
 9. Lube oil
 10. Fuel transfer pump
 11. Fuel priming pump
 12. Fuel oil cooler
 13. Flexible fuel lines (labeled for fuel flow direction)
 14. Engine mounted fuel oil filter
 15. Engine driven water pump

16. Dry type air cleaners with service indicators
17. Closed Loop Crank Case breather system (No oil may be routed to dump on the floor, all must be recycled)

2.04 GOVERNOR

- A. Isochronous governor (electronic type with magnetic pickup) +/- ¼% speed regulation no load to full load

2.05 GENERATOR (IN ACCORDANCE WITH NEMA STANDARD MG1-22.40)

- A. Type
 1. 277/480 volt, 3 phase, wye connected
 2. Drip proof
 3. Permanent magnet excitation
 4. Brushless exciter with static regulator containing no moving parts
 5. Field circuit with inherent protection against excessive field currents or voltages
 6. Heavy duty single ball bearing type
 7. Direct coupled to the engine through a semiflexible coupling
 8. NEMA Class "H" insulation
 9. NEMA Class "F" temperature rise (115o C maximum)
 10. Rating and voltage stamped on a permanent nameplate
 11. Voltage regulator (solid state), +/- 2% from no load to full load
 12. Voltage level adjustment, +/- 5%

2.06 OUTPUT CIRCUIT BREAKER

- A. The generator output circuit breaker(s) shall be mounted on the generator. The circuit breaker shall be molded case, provided with an adjustable electronic trip unit with adjustable LSIG functionality. In addition, the trip unit shall have a ground fault alarm function which is separately adjustable from the ground fault trip setting. The breaker shall have shunt-trip.
- B. Customer Power: Circuit breaker to be molded case, thermal magnetic, 1200A/3Pamperes, 3 pole, 480 VAC, 42 KAIC minimum. Circuit breaker shall incorporate an electronic trip unit with adjustable LSIG trip function.

2.07 INSTRUMENTATION AND CONTROLS

- A. The generator control panel shall be generator mounted and shall provide all operating, monitoring and control functions for the generator set.
- B. The control panel shall include the following functional requirements:
 1. LCD display with text based alarm/event descriptions.
 2. Automatic and manual start/stop controls
 3. Local run/off/auto control

4. Emergency stop pushbutton
 5. Lamp test
 6. Voltage control
 7. Speed control
 8. Password protected system programming
 9. Spare relay - programmable
- C. Controls shall provide the following keypad accessible digital readouts for the engine and generator:
1. Engine
 - a. Engine oil pressure
 - b. Engine oil temperature
 - c. Engine coolant temperature
 - d. Engine RPM
 - e. Battery Volts
 - f. Hours Run
 2. Generator
 - a. AC Voltage (L-L & L-N)
 - b. AC Amps
 - c. Generator AC Frequency
 - d. KW (total & per phase)
 - e. KVA (total & per phase)
 - f. KVAR (total & per phase)
 - g. Power Factor (Average and per phase)
 - h. KWhr (total)
 - i. KVARhr (total)
 - j. % of rated KW (total)
 3. Voltage Regulation
 - a. DC voltage
 - b. DC current
- D. Alarms and Shutdowns (Engine)
1. Low oil pressure alarm/shutdown
 2. High coolant temperature alarm/shutdown
 3. Loss of coolant shutdown
 4. Overspeed shutdown
 5. Overcrank shutdown
 6. Low coolant level alarm
 7. Low fuel level alarm
 8. Emergency stop shutdown
 9. Low coolant temperature alarm
 10. Low battery voltage alarm
 11. High battery voltage alarm

12. Control switch not in auto position alarm
 13. Battery charger failure alarm
- E. Alarms and Shutdowns (Generator)
1. Generator over voltage
 2. Generator under voltage
 3. Generator over frequency
 4. Generator under frequency
 5. Generator reverse power
 6. Generator overcurrent
 7. Generator breaker open
- F. Alarms and Shutdowns (Voltage Regulation)
1. Loss of excitation alarm/shutdown
 2. Instantaneous over excitation alarm/shutdown
 3. Time over excitation alarm/shutdown
 4. Rotating diode failure
 5. Loss of sensing
 6. Loss of PMG
- G. Auxiliary
1. Provide (6) programmable discrete inputs.
 2. Provide (15) discrete outputs which shall be of the dry contact type rated for 120VAC. These outputs shall be configurable in the field but shall be initially configured to provide the following:
 - a. Generator Running
 - b. Generator not in auto
 - c. Generator Pre-High Engine Temp
 - d. Generator High Engine Temp
 - e. Generator Overspeed
 - f. Generator Low Engine Temp
 - g. Generator Low Coolant Level
 - h. Generator Pre-Low Oil Pressure
 - i. Generator Low Oil Pressure
 - j. Generator Fuel Tank Leak
 - k. Generator Battery Charger Fault
 - l. Four (4) Spares
 3. Provide (1) programmable analog output (4-20mA dc):
 - a. One analog (4-20mA dc) output to indicate continuous fuel level to SCADA Panel.
 4. Provide (1) Modbus TCP/IP protocol communication network connection to SCADA. A protocol conversion gateway shall not be required.
- H. Enclosure

1. Mounted Integral to Generator
- I. Indicating Lights
1. Low oil pressure
 2. High coolant temperature
 3. Overspeed
 4. Overcrank
 5. Emergency stop
 6. Fault shutdown
 7. Fault alarms
 8. 3 Spare lights/4 spare inputs
 9. Customer programmable (shutdown or alarm) to spare alarm or fault LEDs
- J. Pre-alarm and LED indicators for
1. Approach high coolant temperature
 2. Low coolant temperature (70 degrees F.)
 3. Approach low oil pressure
 4. Low DC volts
 5. System not in "automatic"
 6. Low fuel level
 7. Fuel in rupture basin

2.08 REMOTE COMMUNICATIONS

- A. Generator control shall include an external Ethernet communication port for connecting to the plant SCADA via Modbus TCP/IP protocol.
- B. Remote serial annunciator panel (RSA) shall be furnished loose for installation at the site by the Electrical Contractor. The RSA shall enable the operator to monitor the status of the generator set from a remote location. The RSA shall be connected via RS-485 Serial Communication using Modbus or other industry standard protocol and a Belden data cable.

2.09 STARTING SYSTEM

- A. 24 volt DC starter motor(s)
- B. Automatic reset circuit breaker to protect against butt engagement of starter motor(s)
- C. Batteries, low maintenance, lead acid type (low antimony) adequately sized per the ambient temperatures stated
- D. Corrosion resistant or coated steel battery rack
- E. Required battery cables

2.10 BATTERY CHARGER

- A. Automatic mode switching type. 10 ampere minimum rating.
- B. Rating of at least 1/20 of the ampere hour rating of the batteries
- C. Factory preset ranges – not field adjustable
- D. DC output +/- 0.2% with AC input variation of +/- 10%
- E. DC voltmeter
- F. DC ammeter
- G. NFPA malfunction alarm contacts

2.11 JACKET WATER HEATER(S)

- A. 240 volts, single phase, sized to manufacturer's recommendations
- B. Adjustable thermostatic control
- C. Isolation valves
- D. Sized to maintain engine jacket water temperature at a minimum of 120 degrees F. when the engine is idle.

2.12 COOLING SYSTEM, ENGINE MOUNTED (AMBIENT RATING OF -35 F TO +120F)

- A. Vertical core with built in expansion tank
- B. Flanged for direct duct connection
- C. Engine driven blower fan
- D. OSHA type fan and belt guards
- E. Low coolant level contactor
- F. 50% ethylene glycol inhibited antifreeze liquid with additives

2.13 EXHAUST SYSTEM

- A. Critical type silencer with thimble.
- B. Silencer configuration shall be for horizontal installation with a bottom inlet, to be mounted to the roof of the generator room.
- C. Mechanical contractor to construct roof support and connect silencer to generator as required. The electrical contractor shall provide dimensions required for mechanical to install.

2.14 FUEL TANK SYSTEM

- A. 12 hour fuel supply at 100% load (500 gallon minimum)

- B. Mounted under the generator, double walled with leak detention to meet PCA requirements.
- C. Coordinate foot print during submittal phase. The intent is to allow the generator manufacturer the freedom to provide a tank that best meets the site requirements. Note: any tank size must fit inside the space available and allow for the generator to also fit in the space, pay special attention to the installation method for the site to ensure the generator will be able to be placed in the space without issues.
- D. Inlet - exterior mounted fuel fill box
- E. Vents top of tank, Normal, Emergency, & Rupture Basin shall be extended through the building wall & include non-corrosive aluminum vent extensions & vent caps. Extensions shall be provided by generator manufacturer and installed by mechanical contractor on site.
- F. Engine return line top of tank
- G. Low level fuel alarm with contacts for remote annunciation, prewired to generator control panel.
- H. Visual Level Indicator
- I. Leak detection alarm.
- J. Fuel level gauge (4-20mA analog output).
 - 1. The generator fuel gauge shall be calibrated to its zero value in the plant SCADA system prior to filling with diesel to provide an accurate high and low level signal.
- K. Drain petcock at bottom of tank.
- L. Utilize flexible metal hose for final connections of fuel supply and return lines
- M. A (4) point lifting means for the total weight of the system less fuel shall be designed into the base.

2.15 ACCESSORIES

- A. Glycol coolant mixture (50%)
- B. Initial fuel fill (blended). See Part 3 for additional information.
- C. OSHA approved ear protectors (four sets).

2.16 LUBE OIL SYSTEM

- A. Forced-feed lubrication system with piston cooling, lube oil circulating pump with safety valve, lube oil filter, lube oil heat exchanger, filler neck, dip stick, and closed crankcase breather system.

2.17 ALL STEEL SKIN TIGHT STYLE WEATHER PROOF ENCLOSURE

- A. A weatherproof enclosure, designed to allow for full load operation of the engine generator system and all of its accessories, sized for the exact unit being installed, shall be supplied. The enclosure shall be sized and equipped with adequate doors for ease of inspection and servicing.
- B. The enclosure shall be insulated with a high density foam insulation
- C. The air openings shall include motor-operated intake and gravity exhaust dampers with fixed louvers on the intake and a 90 degree hood on the outlet sized to allow proper air flow (restriction not to exceed .5" H2O)
- D. Doors shall be installed to allow sufficient access to the generator set and all accessories. All doors shall be hinged and equipped with positive locking assemblies and handles and be weather stripped.
- E. The exhaust silencer shall be internally mounted and equipped with a vertical exhaust and a rain cap.
- F. The enclosure shall arrive at the jobsite completely wired (battery charger, jacket water heater, louver motors, etc.) and ready for final installation.
- G. Enclosure shall be supplied with a 120/240V, 1PH load center as required to feed all generator auxiliary power load requirements. Contractor to make 1 single point of power connection for auxiliary power at the unit.
- H. Provide enclosure with enclosure mounted LED lights to sufficiently light the interior of the enclosure to 20 foot candles. Provide 2 enclosure mounted WP, GFCI duplex general purpose receptacles.
- I. Provide LED wall packs on the exterior of the enclosure to provide 10 foot candles minimum immediately around the generator for maintenance. At a minimum, 1 light fixture shall be installed on each of the two sides of the generator where service doors exist. Exterior lights shall be on their own light switch and be provided with integral photocell. Light fixture shall be manufactured by RAB or Approved Equal.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Coordinate with Electrical Contractor the unloading and proper placement of the engine generator set inside the generator space.
- B. Provide all power feeders per Drawings and connect.
- C. Tighten all lugs and bolts to manufacturer's recommendations.
- D. Neatly dress conductors and bundle with nylon cable ties.

- E. Provide all required control connections between generator control panel and ATS, between generator control panel and SCADA, and between SCADA and ATS.
- F. Provide grounding at generator set location with ground rods and copper conductors as specified in Section 260526 – Grounding and Bonding for Electrical Systems and as indicated on the Drawings.
- G. Use touch-up paint, as recommended by the manufacturer, to repair scratches and other surface defects.

3.02 CHECKOUT & STARTUP

- A. Electrical Contractor shall contract with manufacturer of the electric generating plant and associated items covered herein to provide factory trained technicians to check out the completed installation and to perform an initial startup inspection to include:
 - 1. Ensuring the engine starts (both hot and cold) within the specified time.
 - 2. Verification of engine parameters are within manufacturer's recommendations.
 - 3. Set no load frequency and voltage.
 - 4. Single step load pickup per NFPA 110-1985, Paragraph 5-13.2.
 - 5. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.
 - 6. Test all automatic shutdowns of the engine generator.
- B. Furnish to engineer, a report indicating that installation has been tested by a manufacturer's representative and is installed and operating properly.

3.03 TRAINING

- A. Training for the Owner's personnel shall be for not less than eight (8) hours on the power generation system. The eight hours shall consist of up to two (2) separate four (4) hour sessions on Site.
- B. All training sessions shall be at times that are preapproved with the Owner (7 days minimum advance notice).
- C. Training shall be in accordance with Division 1 requirements.

3.04 WIRING

- A. Wiring of the engine generator set, switchgear, lighting, outlets, panelboard, transformer, ventilation and other components of the integrated generation system shall meet all State requirements. These requirements shall include, but are not limited to:
 - 1. Applying and paying for an electrical construction permit.

2. Installation by an electrician appropriately licensed by the State in which the project is located in.
3. Inspection and approval by an electrical inspector recognized by the State to which the project is located in.

3.05 TESTING

A. Testing During Fabrication

1. Engine Generator. The power generation system manufacturer or fabricator shall have:
 - a. The power generation system is to be tested as a complete unit including engine, generator, excitation system, together with all subsystems in the enclosure and cooled by the engine radiator and fan.
 - b. The manufacturer shall provide all equipment for the test including, but not limited to, ammeters, voltmeters, fuel supply, frequency meter, and load banks capable of 10% maximum steps to 100% of the engine generator's continuous standby rating; and the addition, in one step of 50% of the continuous standby rating from a 50% continuous standby rating load point, or removal of the total load from the generator in one step. The load banks shall be connected through the switchgear. The load bank shall be connected to the power generation system's load terminals. The test program will cover the following items:
 - 1) Extended operation at 100% of continuous-standby rating, 2 (two) hours minimum.
 - 2) 50% load to 100% load test with a +10%-15% from nominal voltage dip, maximum, permitted with frequency fluctuation measurement. Code F motor inrush characteristics. Frequency deviation shall not exceed 3 cycles for 2 seconds.
 - 3) Engine protective device evaluation.
 - 4) No load operation with an addition of load to 50% of rating with 15% voltage dip maximum and frequency fluctuation not exceeding 2 cycles for 2 seconds.
 - 5) Various 10% load additions and subtractions.
 - 6) Evaluation of subsystems, noise, component installation and interconnections, workmanship, quality, engine and generator performance, etc.
 - 7) The test program will not start without all required equipment, including but not limited to load banks and voltmeter as required.

B. Site Testing

1. After installation, but prior to acceptance for substantial completion, the system shall undergo formal onsite testing. This testing will be witnessed by representatives of the Owner and the Engineer. The testing will include, but not be limited to:
 - a. Demonstration of system features and functions.
 - b. Machine performance.
 - c. Use project loads and a separate resistive load bank equal to the generator capacity for testing purposes. Unit shall be tested as follows:
 - 1) With generator in a “cold start” condition and load at normal operating level, initiate a normal power failure by opening all switches or breakers supplying normal power to the facility. Test load shall be that load which is served by the generator.
 - 2) Observe and record the time delay on start.
 - 3) Observe and record the cranking time until the generator starts and runs.
 - 4) Observe and record the time required to come up to operating speed.
 - 5) Record voltage and frequency overshoot.
 - 6) Observe and record time required to achieve steady-state condition with all switches transferred to the emergency/standby position.
 - 7) Record voltage, frequency and amperes.
 - 8) Continue load test with building load for one (1) hour, observing and recording load changes and the resultant effect on voltage and frequency.
 - 9) Return normal power to the facility, record the time delay on retransfer to normal (set to 15 minutes minimum) and the time delay on the generator cool down period and shutdown.
 - 10) Confirm and record the time delays associated with the delayed transition feature of the switch and the “pre-transfer” signal to SCADA.
 - 11) Perform a crank cycle test. Utilize any method recommended by the manufacturer to prevent the generator from running. Put the control switch into the “run” position to cause the generator to crank. Observe the complete crank/rest cycle specified and record.
 - 12) After successful testing with the available facility loads, provide a resistive load bank to test the generator at full specified load at 1.0 power factor. Run generator at full load for two (2) hours. Record generator oil pressure,

water temperature, and battery charge rate, voltage, frequency, and amperes at 5 minute intervals for the first 15 minutes and at 15 minute intervals thereafter.

- 13) Test all safeties specified, as recommended by the manufacturer.
 - d. Perform testing at time preapproved by Owner and Engineer (7 day prior notice, minimum).
 - e. Submit record of site test procedures and results and include a copy in the O&M manuals.
2. If the system is not accepted or does not perform satisfactorily, repairs shall be completed, and the unit retested until it performs to the Owner, Utility, and the Engineer's satisfaction.

3.06 FUEL

- A. Provide all diesel fuel for initial startup, training and testing procedures.
- B. Provide \$1,000 worth of fuel in the fuel tank (winter blend diesel fuel) at project completion. Intent is to leave the tank filled to at least half full capacity prior to leaving site. Provide copies of all fuel receipts to the Engineer to confirm quantity of fuel provided. Demonstrate fuel tank level to the Engineer and Owner prior to leaving site at project completion.

3.07 SUPPLIES AND SPARE PARTS

- A. Provide all supplies, spare parts, expendable items and related equipment for initial startup, training and testing procedures.
- B. At project completion, provide Owner with a complete set of spare parts for the equipment, including, but not limited to lamps, fuses, etc. Provide ten (10) percent spare fuses and lamps of each type furnished under this Section, but not less than three (3) of each type.

END OF SECTION

SECTION 26 36 00
AUTOMATIC TRANSFER SWITCH

PART 1 **GENERAL**

1.01 SUMMARY

- A. The Contractor shall furnish and install the low voltage automatic transfer switch(es) having the ratings, features/accessories and enclosures as specified herein and as shown on the contract drawings, as part of a complete backup power system.

1. SW57-ATS1 Automatic Transfer Switch
- | | |
|-------------------------------|-----------------------------|
| Ampacity: | 2500 A |
| Service Entrance Rated: | Yes |
| Main Circuit Breaker Required | Yes - Drawout |
| Maintenance Bypass Required: | Yes |
| Voltage: | 277/480V 3PH |
| kAIC Rating: | 65 KAIC |
| # of Poles: | 3 Pole Non-Switched Neutral |
| Transition Type: | Delayed |
| Enclosure Type: | NEMA 3R |
| Lug Type: | Compression |
| Arc Flash Maintenance Switch: | Yes |

- B. The Emergency Power System consists of the following as applicable:

1. Section 26 05 19 - Power and Instrumentation Cable - Less Than 600V
2. Section 26 05 34 - Conduit
3. Section 26 05 53 - Identification for Electrical Systems
4. Section 26 32 13 - Engine Generators

1.02 DESCRIPTION OF SYSTEM

- A. An electrically operated switch is automatically operated during a utility power service interruption and the system can also be manually controlled by the System Operator to transfer the load from the utility source to the fixed engine generator source.

1.03 CODES AND STANDARDS

- A. UL 1008 - Standard for Transfer Switch Equipment
- B. NFPA 70 - National Electrical Code
- C. NFPA 110 - Emergency and Standby Power Systems

1.04 ACCEPTABLE MANUFACTURERS

- A. ASCO Power Technologies - Series 7000
- B. Prior Approved Equal

1.05 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit in accordance with Specification Section 01 33 00 - Submittals.
- B. Clearly indicate voltage, amperage, dimensions, installed weight, electrical connections, time delays, enclosure type, short circuit withstand rating.

1.06 TEST REPORTS

- A. Furnish a report indicating that the transfer switch is adjusted to the manufacturer's recommendations.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Store in a dry area, protected from the weather.

1.08 OPERATION AND MAINTENANCE DATA

- A. Submit manufacturer's instructions in accordance with Specification 01 78 23 - Operation and Maintenance Data for maintaining, operating the transfer switch including repair parts list, adjusting time delay relays, troubleshooting guide, wiring schematic.

1.09 PROVIDE SEISMIC TESTED EQUIPMENT AS FOLLOWS:

- A. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest International Building Code (IBC).
- B. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
- C. The IP rating of the equipment shall be 1.5
- D. The Structural Engineer for the Site will evaluate the SDS values published by the Manufacturer to ascertain that they are "equal to" or "greater than" those required for the Project Site.
- E. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - 1. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.

2. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- F. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

PART 2 PRODUCTS

2.01 AUTOMATIC TRANSFER SWITCH

- A. The transfer switch shall be rated as indicated in section 1.01 of this specification.
- B. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single solenoid mechanism. Main operators utilizing overcurrent disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.
- C. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.
- D. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.
- E. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow on construction for high withstand and close on capability and be protected by separate arcing contacts.
- F. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.
- G. Designs utilizing components of molded case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.
- H. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

2.02 MICROPROCESSOR CONTROLLER

- A. The controller's sensing and logic shall be provided by a single built in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module or Ethernet connectivity module.
- B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to $\pm 1\%$ of nominal voltage. Frequency sensing shall be accurate to $\pm 0.2\%$. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.
- C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multilayer printed circuit boards. Interfacing relays shall be industrial grade plug in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built in pocket for storage of the operator's manuals.
- D. All customer connections shall be wired to a common terminal block to simplify field wiring connections.
- E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:
 - 1. EN 55011:1991 Emission standard - Group 1, Class A
 - 2. EN 50082-2:1995 Generic immunity standard, from which:
 - 3. EN 61000-4-2:1995 Electrostatic discharge (ESD) immunity
 - 4. ENV 50140:1993 Radiated Electro-Magnetic field immunity
 - 5. EN 61000-4-4:1995 Electrical fast transient (EFT) immunity
 - 6. EN 61000-4-5:1995 Surge transient immunity
 - 7. EN 61000-4-6:1996 Conducted Radio-Frequency field immunity
 - 8. IEEE472 (ANSI C37.90A) Ring Wave Test.

2.03 ENCLOSURE

- A. The ATS shall be installed within an enclosure with rating as defined in Section 1.01.
- B. All standard door mounted switches and indicating lights described in Section 3 shall be integrated into a flush mounted, interface membrane or equivalent in the interior enclosure door for easy viewing & replacement. The panel shall include a manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering.

2.04 ACCESSORIES

- A. Pre-Transfer Signal: The transfer switch shall be provided with an adjustable “pre-transfer” signal (dry contact) that can be wired to the plant SCADA system for monitoring. The signal shall be active in transfer in either direction (from utility to generator and from generator back to utility). The intent of the signal is to wire it to SCADA so that the large plant motor loads can be sequenced off prior to transfer and then sequenced on after transfer.
- B. Load Shed Signal: The transfer switch shall accept a “load shed” or “generator start and transfer” signal from a remote source such as the plant SCADA system or the serving electrical utility.
- C. Auxiliary Contacts: Provide two (2) auxiliary contacts that indicate “Normal” position of the switch and two (2) auxiliary contacts that indicate “Emergency” position of the switch. The contacts shall be available for the Owner’s use.
- D. Delayed Transition Operation: The automatic transfer switch shall be of the “delayed transition” type that includes an “intermediate Off” position during transfer along with an adjustable time delay to allow large motors to coast to a complete stop and transformer fields to completely decay prior to transfer. This feature ensures that inductive loads are “re-energized” after transfer with only normal starting inrush currents.

2.05 CONTROLLER DISPLAY AND KEYPAD

- A. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the communications interface port. The following parameters shall only be adjustable via DIP switches on the controller:
- B. Nominal line voltage and frequency
- C. Single or three phase sensing
- D. Operating parameter protection
- E. Transfer operating mode configuration
- F. (Open transition)
- G. All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

2.06 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

- A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<u>Parameter</u>	<u>Source(s)</u>	<u>Dropout / Trip</u>	<u>Pickup / Reset</u>
Undervoltage	N&E, 3 Phase	70% to 98%	85% to 100%
Overvoltage	N&E, 3 Phase	102% to 115%	2% below trip
Underfrequency	N&E	85% to 98%	90% to 100%
Overfrequency	N&E	102% to 110%	2% below trip
Voltage Unbalance	N&E	5% to 20%	1% below trip

- B. Repetitive accuracy of all settings shall be within $\pm 0.5\%$ over an operating temperature range of -20 deg C to 60 deg C.
- C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via the communications interface port.
- D. The controller shall be capable (when activated by the keypad or the communications interface port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).
- E. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases, frequency, and phase rotation.

2.07 TIME DELAYS

- A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.
- B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.
- C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.
- D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.
- E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:
 - 1. Prior to transfer only.
 - 2. Prior to and after transfer.

3. Normal to emergency only.
 4. Emergency to normal only.
 5. Normal to emergency and emergency to normal.
 6. All transfer conditions or only when both sources are available.
- F. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.
- G. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the communications interface port.

2.08 ADDITIONAL FEATURES

- A. Membrane type switches shall be provided for the test and retransfer to normal functions. The test position will simulate a normal source failure. The retransfer to normal position shall bypass the time delays on retransfer to normal.
- B. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.
- C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.
- D. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).
- E. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.
- F. A membrane switch shall be provided on the membrane panel to test all indicating lights when pressed.
- G. The following features shall be built into the controller, but capable of being activated through keypad programming or the communications interface port only when required by the user:
- H. Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.
- I. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or the communications interface port.

- J. An Inphase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The inphase monitor shall be specifically designed for and be the product of the ATS manufacturer. The inphase monitor shall be equal to ASCO Feature 27.
- K. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non automatic mode when a non automatic version of the user interface membrane is furnished.
- L. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:
 - 1. Enable or disable the routine.
 - 2. Enable or disable transfer of the load during routine.
 - 3. Set the following:
 - a. start time
 - b. time of day
 - c. day of week
 - d. week of month (1st, 2nd, 3rd, 4th, alternate or every)
 - 4. Set the duration of the run.
 - a. At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10 year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.
- M. Key Locking Feature - The control switches on the interface membrane shall be capable of being locked via password protected screens on the controller LCD display to prevent unauthorized tampering. A red LED indicator shall be illuminated on the interface membrane when the membrane controls are locked.
- N. System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example:
 - 1. Normal Failed
 - 2. Load on Normal
 - 3. TD Normal to Emerg
 - 4. 2min15s
- O. Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.

- P. Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.
- Q. Communications Interface Module (Applicable to SE - The controller shall be able to connect via an Ethernet connectivity module (over standard 10baseT Ethernet networks). This module shall allow for seamless integration of existing or new communication transfer devices. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters. The transfer switch shall also be able to interface to 3rd party applications using ModbusTCP/IP open standard protocols. The communication interface modules shall be as follows
1. ASCO Accessory 72E (10BaseT Ethernet) or Approved Equal
- R. Data Logging - The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:
- S. Event Logging
1. Data and time and reason for transfer normal to emergency.
 2. Data and time and reason for transfer emergency to normal.
 3. Data and time and reason for engine start.
 4. Data and time engine stopped.
 5. Data and time emergency source available.
 6. Data and time emergency source not available.
- T. Statistical Data
1. Total number of transfers.
 2. Total number of transfers due to source failure.
 3. Total number of days controller is energized.
 4. Total number of hours both normal and emergency sources are available.
- U. External DC Power Supply - Provide the ability to be able to connect an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead.
1. ASCO accessory 1G or approved equal
- V. For circuit breakers rated 1200A and up the trip units shall be equipped with Arcflash Reduction Maintenance System (ARMS) Technology capability. The Arcflash Reduction Maintenance System shall allow the operator to enable a maintenance mode which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode.

2.09 WITHSTAND AND CLOSING RATINGS

- A. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
- B. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long time ratings. ATS's which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

2.10 TESTS AND CERTIFICATION

- A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
- C. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

2.11 SERVICE REPRESENTATION

- A. The ATS manufacturer shall maintain a national service organization of company employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.
- B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

PART 3 EXECUTION

3.01 GENERAL

- A. Securely mount transfer switch where indicated.
- B. Provide all power and control connections.
- C. Test for proper operation and adjust time delay relays to manufacturer's and/or the serving Utilities recommendations.

- D. All as-programmed ATS settings shall be documented within the final O&M submitted for the ATS.

3.02 TRAINING

- A. Training on the project ATS shall be for four (4) hours, minimum on site. The training sessions shall consist of two (2) separate, two (2) hour sessions at Site. The Owner may record the training sessions.
- B. All training sessions shall be at times that are prior approved with the Owner. Two week prior approval of all training sessions is required.

3.03 SUPPLIES

- A. At Final Completion, Contractor shall furnish the following expendable items:
 - 1. Ten (10) percent spare fuses and lamps of each type furnished under this Section, but not less than three (3) of each type.

3.04 MEASUREMENT AND PAYMENT

- A. Payment for all work specified in this section shall be included in the Lump Sum Bid Price as indicate on the Bid Form. See for the Bid Form for any additional requirements that may be required.

END OF SECTION

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SECTION 26 42 10

GALVANIC CATHODIC PROTECTION

PART 1 GENERAL

1.01 WORK INCLUDED

- A. This section covers the work necessary to furnish and install galvanic cathodic protection and joint bonding for electrical continuity on all buried metallic piping and appurtenances associated with the vault improvements water piping as shown on the Drawings and specified herein, complete.
- B. The quantity and location of the specified galvanic anodes are provided on the Drawings. Anode material has been selected based on the soil conditions of the installation location.
- C. Galvanic anode installations include anodes directly connected to the pipe/appurtenance, where specified, and anodes connected to the pipe through Type A test stations.
- D. All buried metallic pipe and appurtenances shall be coated with a bonded dielectric coating, as shown on the Drawings and specified herein, complete.

1.02 DEFINITIONS

- A. Ferrous Metal Pipe: Pipe made of steel or iron, or pipe containing steel or iron as a principal structural material, except reinforced concrete pipe.
- B. Foreign-Owned: Buried pipe or cable not specifically owned or operated by the OWNER.
- C. Lead, Lead Wire, Joint Bonds, Pipe Connecting Wires, Cable: Insulated copper conductor; the same as wire.
- D. Electrically Continuous Pipeline: A pipeline which has a linear electrical resistance equal to or less than the sum of the resistance of the pipe plus the maximum allowable bond resistance for each joint as specified in this section.

1.03 REFERENCES

- A. The Association for Materials Protection and Performance (AMPP)
- B. National Association of Corrosion Engineers (NACE) International.

1.04 STANDARDS:

- A. The following standards are included by reference:
 - 1. AMPP/NACE International
 - a. NACE SP-0169
 - b. NACE SP-0177

1.05 SUBMITTALS

- A. Shop Drawings: Catalog cuts, laboratory report, and other information for products proposed for use.
- B. Quality Assurance Submittals:
 - 1. Manufacturers' Certificates of Compliance.
 - 2. Field Test Reports.

PART 2 PRODUCTS

2.01 GENERAL

- A. Like items of materials provided hereunder shall be the product of one manufacturer to achieve standardization for appearance, maintenance, and replacement.
- B. The use of a manufacturer's name and model or catalog number is for establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with the General Conditions.
- C. Materials and workmanship as specified in this section shall be installed concurrently with pipe installation. Coordinate all work specified herein with related sections.

2.02 SUPPLIERS

- A. Alternate suppliers will be considered, subject to approval of the ENGINEER. Location provided is that of the general office; contact these offices for information regarding the location of their representative nearest the project site.
 - 1. Corpro, Houston, TX.
 - 2. Farwest Corrosion Control, Downey, CA.
 - 3. Mesa Products, Tulsa, OK.

2.03 GALVANIC ANODES

- A. **High-Potential Magnesium Alloy (Prepackaged-Backfill Supplied):**
 - 1. Composition:
 - a. Aluminum: 0.01 percent maximum.
 - b. Manganese: 0.5 to 1.3 percent.
 - c. Zinc: 0.
 - d. Silicon: 0.
 - e. Copper: 0.02 percent maximum.
 - f. Nickel: 0.001 percent maximum.
 - g. Iron: 0.03 percent maximum.
 - h. Total Others: 0.05 percent each or 0.3 percent maximum, total.
 - i. Magnesium: Remainder.
 - 2. Dimensions:
 - a. Bare Weight: 32 pounds or as shown on the Drawings.
 - b. Packaged Size: 6.5" W by 63" L
 - 3. Manufacturers and Products:
 - a. Dow; Galvomag.
 - b. Amax; Maxmag.

- c. Approved equal.

B. Backfill:

1. Composition:
 - a. Ground Hydrated Gypsum: 75 percent.
 - b. Powdered Wyoming Bentonite: 20 percent.
 - c. Anhydrous Sodium Sulfate: 5 percent.
2. Grain Size: 100 percent passing through a 20-mesh screen and 50 percent retained by a 100-mesh screen.
3. Mixture: Thoroughly mixed and firmly packaged around the galvanic anode within the cloth bag or cardboard tube by means of adequate vibration.
4. The quantity of backfill shall be sufficient to cover surfaces of the anode to a depth of 1 inch.

2.04 CATHODIC PROTECTION TEST STATIONS:

A. Post Mounted (hot-dipped Galvanized Steel Post):

1. Test Station Head: Type A, T, I, and F: Testox series 700 or 1000 series test head.
2. Terminal Block: Plastic with minimum seven terminals. Terminal heads shall have special heads to keep them from turning or shall be easily accessible from both sides of the terminal block without requiring its removal. Terminal studs, washers, and nuts shall be stainless steel.
3. Mounting Post: 2-inch diameter by 5 foot long hot-dipped galvanized steel post.
4. Mounting Hardware: Conduit, straps, nipple, reducer, and hardware for mounting test station to the post as specified under CONDUIT, LOCKNUTS, AND STRAPS.
5. Manufacturers and Products: Testox 700 and 1000 series test station as manufactured by Gerome Manufacturing, Uniontown, PA.

B. Test Station Wires:

1. General: Conform to applicable requirements of NEMA WC 3-80, WC 5-73, and WC 7-88.
2. Single-conductor, No. 10 AWG stranded copper with 600-volt TW, THWN, or THHN insulation.
3. Galvanic Anode Header Wire: Single-conductor, No. 8 AWG, stranded copper with 600-volt HMWPE insulation.
4. Insulation Color/Identification: Wire insulation color shall indicate the function of each wire and shall be as follows:
 - a. Anodes/Header Cable: Black
 - b. Pipelines: White
 - c. Stationary Reference Cell: Yellow
 - d. Foreign Pipeline: Red (gas), Blue (water)
 - e. Insulated Joints: Green (insulated side), White (protected side)

C. Stationary Reference Electrodes:

1. Prepackaged Copper-Copper Sulfate Reference Electrodes:
2. Material: High impact ABS, ceramic with Moisture Retention Membrane.
3. Dimensions: 1.5" by 10.5" or 1" by 8".
4. Wire: Minimum 14 AWG stranded copper wire with yellow, 600-volt TW, THWN, or THHN insulation. The wire shall be attached to the electrode and insulated with the manufacturer's standard connection. Connection shall be stronger than the wire.

5. Packaging: Furnish electrode packaged in a plastic or heavy paper bag of sufficient thickness to protect the electrode, backfill, and cloth bag during normal shipping and handling.
6. Manufacturers:
 - a. Borin Manufacturing, Stelth 2 Series
 - b. MC Miller, IonX Permanent Reference Electrode

2.05 JOINT BONDS

A. Ductile or Cast Iron Pipe:

1. Single-conductor, stranded copper wire with 600-volt HMWPE insulation. Supply joint bonds complete with a formed copper sleeve on each end of the wire.
2. No. 2 AWG wires, 18 inches long.

B. Flexible Coupling, Flanged Coupling Adapter, and Other Non-standard Joints:

1. Ductile Iron Pipe: No. 2 AWG wires, 24 inches long, HMWPE insulation, with 12-inch long THHN insulated No. 12 AWG wire pigtails, as manufactured by Erico Products Inc. (Cadweld), Cleveland, OH.

C. Insulated Flexible Coupling Joints:

1. Ductile Iron Pipe: No. 8 AWG HMWPE wire, 18-inch long, with one 12-inch long THHN or HMWPE insulated No. 12 AWG wire pigtail.
2. Steel Pipe: Solid copper strap, 1-1/4-inch wide by 1/16-inch thick, equivalent to 1/0 AWG wire, with four punched holes for thermite welding to the coupling and pipe. Strap bond shall be fabricated for the length of the coupling with sufficient additional length for 1 inch of joint movement. Weld bonds to pipe with the thermite weld mold recommended by the bond manufacturer. Strap bond shall be as manufactured by Erico Products, Continental Industries, or approved equal.

2.06 THERMITE WELD MATERIALS

A. General:

1. Thermite weld materials consist of wire sleeves, welders, and weld cartridges according to the weld manufacturer's recommendations for each wire size and pipe or fitting size and material.
2. Welding materials and equipment shall be the product of a single manufacturer. Interchanging materials of different manufacturers is not acceptable.

B. Molds: Graphite.

C. Adapter Sleeves:

1. For No. 12 AWG and No. 2 AWG wires.
2. Prefabricated factory sleeve joint bonds or bond wires with formed sleeves made in the field are acceptable. Attach field-formed joint bonds sleeves with the appropriate size and type of hammer die furnished by the thermite weld manufacturer.
3. Extend wire conductor 1/8 inch beyond the end of the adapter sleeve.

D. Cartridges:

1. Steel: 32 grams, maximum.
2. Cast and Ductile Iron: 32 grams, **maximum**, XF-19 Alloy, specifically for use on cast iron and ductile iron.

E. Welders and Cartridges: For attaching copper wire to pipe material:

Pipe Material	Weld Type	Cartridge Size, Max.
No. 4 AWG Wire & Smaller		
Steel	HA, VS, HC	25 gm
Ductile or Cast Iron	HB, VH, HE	32 gm
No. 2 AWG Wire Joint Bonds		
Steel	FS	32 gm
Ductile or Cast Iron	FC	45 gm

F. Welding Materials Manufacturers:

1. nVent/Erco Products Inc. (Cadweld), Cleveland, OH.
2. Continental Industries, Inc. (Thermo-Weld), Tulsa, OK.

2.07 COATING REPAIR MATERIAL FOR PIPE AND FITTINGS

A. General:

1. Complete coating repairs in accordance with recommendations of the pipe or fitting manufacturer.
2. Coat steel pipe with epoxy coating repair as specified.
3. Coat thermite weld connections to ductile or cast iron pipe with fast cure epoxy OR petrolatum wax tape, as specified under Wax Tape Coating System.

B. Epoxy Coating:

1. 100 percent solids, fast curing epoxy suitable for submerged or buried conditions.
2. Acceptable products and manufacturers or equal:
 - a. Protal 7125, 7200, or 7300 Denso North American, Houston, TX.
 - b. TC 7010, Tapecoat, Evanston, IL.
 - c. 3M; ScotchKote 323.
 - d. Aquata-poxy, American Chemical Corp., East Lake, OH.
 - e. "Or-equal."

C. Wax Tape Coating:

1. Buried thermite welds shall be coated in accordance with AWWA C217.
2. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.
3. All components of the wax tape coating system shall be from a single manufacturer as manufactured by Denso North American, Trenton, or equal.

2.08 COATING MATERIAL FOR METALLIC PIPE AND FITTINGS

A. General:

1. All metallic fittings, valves, and metallic hardware (nuts, bolts, etc.) associated with non-metallic pipe construction shall be dielectrically coated with a bonded coating.
2. Prepare surface of items to be coated in accordance with coating manufacturer's requirements and as specified herein.

B. Dielectric Coating Systems for Metallic Pipe, Fittings, and Appurtenances

1. Wax Tape Coating System

- a. Metallic piping, fittings, and appurtenances shall be coated in accordance with AWWA C217.
- b. Apply coating system to all buried metallic pipe appurtenances, including joints, fittings, bolts, and irregularly shaped surfaces.
- c. Do not use wax tape coating systems on vault piping, atmospherically exposed piping and appurtenances, or where subject to UV exposures.
- d. Provide wax tape coating system filler material to fill and smooth all irregular surfaces, such that no tenting or voids remain under the applied wax tape.
- e. Use sand backfill to protect wax coating from damage.
- f. Coating System:
 - (1) Surface Preparation: As required by coating manufacturer. Remove all dirt and debris from pipe surface. Pipe surface shall be completely dry before application of wax tape components.
 - (2) Primer: petroleum or petrolatum wax.
 - (3) Filler Material: petroleum or petrolatum wax sealer/filler with closed cell plastic filler.
 - (4) Inner Tape: Petroleum or petrolatum wax impregnated fabric, 6-inch width maximum, 40 mils thick.
 - (5) Protective Outerwrap (for burial in native soil, not required for sand backfill).
 - (a) Provide fiber mesh fabric outerwrap over wax tape resin coated, woven fiber-mesh fabric that is .005 inches. Protect coating from damage and use sand backfill to protect wax coating from damage.
- g. All components of the wax tape coating system shall be from a single manufacturer as manufactured by Denso North American, Trenton, or equal.

2. Epoxy Coating System

- a. Fusion Bonded Epoxy
 - (1) Prepare surface and apply coating in accordance with C213 and coating manufacturer's guidelines.
 - (2) Apply minimum dry film thickness of 12 mils.
- b. Polyamide Epoxy
 - (1) Prepare surface as required by coating manufacturer and apply coating in accordance with C210 and coating manufacturer's guidelines.
 - (2) Apply minimum of two coats at a total minimum dry film thickness of 12 mils.

2.09 INSULATING JOINTS:

- ### A. General:
- Insulating joints shall be dielectric unions, flanges, or couplings. The complete assembly shall have an ANSI rating equal to or higher than that of the joint and pipeline. All materials shall be resistant for the intended exposure, operating temperatures, and products in the pipeline.

B. Insulating Flanges:

1. Complete assembly shall have an ANSI rating of 150 pounds, minimum, or equal to or higher than that of the joint and pipeline.
2. Gasket materials shall be resistant to intended chemical exposure, operating temperatures, and pressures in the pipeline.
3. Gaskets: Full-face Type E with O-ring seal.
4. Insulating Sleeves: Full-length fiberglass reinforced epoxy (NEMA G 10 grade).
5. Insulating Washers: Fiberglass reinforced epoxy (NEMA G 10 grade).]
6. Steel Washers: Plated, hot-rolled steel, 1/8 inch thick.
 - a. Provide two washers per bolt for flange diameters equal to or less than 36-inch diameter.
 - b. Provide four washers bolt for flange diameters larger than 36-inch diameter.
7. Manufacturers:
 - a. GPT, Denver, CO.
 - b. Central Plastics Co., Shawnee, OK.
 - c. Advance Products and Systems, Scott, LA
 - d. Approved Equal.
8. Insulating Unions: O-ring sealed with molded and bonded insulating bushing to union body.
 - a. Manufacturer:
 - (1) Central Plastics Co., Shawnee, OK.
 - (2) Or approved equal.

2.10 ANCILLARY MATERIALS

A. Wire Connectors: One-piece, tin-plated crimp-on ring tongue connector as manufactured by Burndy Co. or Thomas and Betts.

B. Compression Connectors:

1. For in-line, tap, and multi-splice, furnish "C" taps made of conductive wrought copper, sized to fit the wires being spliced.
2. Provide crimp tool and dies as recommended by the manufacturer for the wire and connector size.
3. Manufacturer and Product: Burndy; Type YC, or equal.

C. Electrical Tape:

1. Linerless rubber high-voltage splicing tape and vinyl electrical tape suitable for moist and wet environments.
2. Use Scotch 130 C and Scotch 88 as manufactured by 3M Products.

PART 3 EXECUTION

3.01 GENERAL

- A. Install galvanic anodes for cathodic protection of metallic pipe and appurtenances where shown on the Drawings.
- B. Installation of anodes to be performed in conjunction with pipeline trenching and as specified in other sections.

- C. All materials and equipment associated with joint bonding, cathodic protection, and coatings, as shown and specified herein, shall be furnished and installed by the Contractor. Any changes in design or method of installation of an item as specified shall be reviewed by the Engineer.
- D. The Contractor shall coordinate the installation of the specified items with the General Contractor or other subcontractors on the project such that installation of the items herein specified can be completed concurrently with pipeline installation. Items not installed before backfilling of the pipe shall be installed at the Contractor's sole expense.
- E. Whenever the requirements of the Specifications or Drawings exceed those of the codes or manufacturer's instructions, the requirements of the Specifications or Drawings shall prevail. Where a larger size or better grade of material or a higher standard of workmanship is required, the most stringent requirement shall apply.

3.02 STORAGE AND HANDLING

- A. Store all packaged anodes, anode backfill, and associated materials off the ground and keep them dry at all times.
- B. Protect materials against weather, condensation, and mechanical damage. Immediately remove from site all damaged anodes.
- C. Anode backfill material that has become wet will not be acceptable.

3.03 GALVANIC ANODE INSTALLATION

- A. General: Install galvanic anodes as shown on the Drawings.
- B. Remove anode packaging materials prior to installing anode.
- C. Provide a minimum anode spacing of 5 feet from the protected structure, other unprotected pipelines, thrust blocks, or adjacent structures, unless approved otherwise by the Engineer. Anode depth shall be at or below the pipe depth, and not less than 4 feet below the finished grade.
- D. Connect anode lead wire directly to the pipe / fitting or route to test station as specified on the Drawings.
- E. After installation, flood each anode with a minimum of 5 gallons of water.
- F. Thoroughly compact backfill around each anode to a point 1 foot above the anode.

3.04 PIPE JOINT BONDING

- A. To form an electrically continuous pipeline and associated appurtenances, the joints of all buried steel and iron pipe, vault and manhole piping, fittings, and restrained joints shall be provided with joint bonds as specified herein, except joints specified to be threaded, welded, or insulated.
- B. Mechanical pipe connections are not considered to provide electrical continuity and require joint bonds, except where specified or approved by Engineer. All metallic components associated with appurtenances and fittings, including follower rings and retainer glands shall be electrically bonded to the piping system.

- C. Contractor shall consider options for thermite welding to follower rings and retainer glands to aid in welding to surfaces with limited space and to avoid potential damage from discharged thermite weld metal. Options could include completing thermite welds on the follower rings and retainer glands prior to installation on pipe or utilizing alternate welding method.
- D. Quantity of joint bonds for fittings and appurtenances shall be as shown on the Drawings.
- E. Electrical connection of all wires to pipe and fittings shall be by the thermite weld process.
- F. Each bonded joint shall be tested as specified under ELECTRICAL CONTINUITY TESTING, this section.

3.05 TEST STATION INSTALLATION:

- A. Location, type, and style of test stations shall be as shown on the Schedules on Drawings. Final field location shall be determined based on actual site conditions and as approved by the ENGINEER.
- B. Testy stations shall be located outside of roadways and adjacent to permanent structures where possible.
- C. Wires to foreign-owned pipelines will be attached by pipeline owner, unless permission is granted to Contractor in writing by owner of foreign pipeline. Coordinate this Work with owner of foreign pipeline before pipe is excavated.
- D. Attach all test wires to the pipe by the thermite weld method unless approved otherwise.
- E. The wires from the test stations shall be buried a minimum of 36 inches below finished grade. Provide 12-inch loop in wires at pipe and beneath test station to prevent them from being stressed or broken during backfilling operations.
- F. Test wires within paved roadways and with less than 36 inches of ground cover shall be installed in rigid PVC-coated steel conduit, except when located under concrete floor slabs.
- G. Make wire connections to test station terminals with crimp-on ring tongue terminals, except where solid wire is specified.
- H. Wire Labels:
 - 1. Install labels on conductors in test stations.
 - 2. Position markers in boxes so they do not interfere with operation and maintenance.

3.06 WIRE CONNECTIONS

A. Thermite Weld:

- 1. Use thermite weld method for electrical connection of copper wire to steel, ductile, and cast iron surfaces. Observe proper safety precautions, welding procedures, thermite weld material selection, and surface preparation recommended by the welder manufacturer. Assure that the pipe or fitting wall thickness is of sufficient thickness that the thermite weld process will not damage the integrity of the pipe or fitting wall or protective lining.

2. After the weld connection has cooled, remove slag, visually inspect, and physically test wire connection by tapping with a hammer; remove and replace any defective connections.
3. On pipe and fittings with dielectric linings, make the weld connection on the shop tab provided or on a thick metal section to minimize damage to the lining and coating. After the weld is made, coat the weld with coating repair material.
4. Coat each completed wire connection as specified, this section.
5. If the lining is damaged by welding, repair it in accordance with the lining applicator's recommendations.

3.07 WIRE INSULATION REPAIR

- A. Splicing of wire will not be permitted except where specifically shown on the drawings and approved by the Engineer.
- B. Splices or damage to the wire insulation shall be required by spirally wrapping with two coats of high-voltage rubber splicing tap and two layers of vinyl electrical tape.
- C. Make wire splices with suitable sized compression connectors or mechanically secure and solder with rosin cored 50/50 solder.

3.08 INSULATED JOINTS:

- A. Install insulated joints to electrically isolate the pipeline from vault piping, electrically grounded facilities, and where shown on the Drawings.
- B. Align and install insulating joints according to the manufacturer's recommendations to avoid damaging insulating materials.
- C. After assembly of insulated flanges, prepare cement-mortar surface in accordance with paint manufacturer's instructions and apply a 20-mil minimum thickness of EPA potable water approved, 100 percent solids water or air curing epoxy coating to the interior of the pipeline. Apply coating for a minimum of two pipe diameter lengths from the insulating flange in both directions. Apply and cure coating in accordance with the manufacturer's recommendations. Do not apply coating where it will interfere with operation of pipeline valves or other pipeline assemblies.
- D. The CONTRACTOR shall test each insulated joint for electrical insulation as specified this section. Defective insulating joints shall be repaired by the CONTRACTOR at his sole expense. All damaged or defective insulation parts shall be replaced.

3.09 TESTS AND INSPECTION

- A. Electrical Continuity Testing:
 1. General
 - a. Furnish all necessary equipment and materials and make all electrical connections to the pipe as required to test continuity of bonded joints.
 - b. Conduct a continuity test on all buried joints that are required to be bonded. Test the electrical continuity of joint bonds after the bonds are installed but before backfilling of the pipe.
 - c. The Contractor shall test completed joint bonds for electrical continuity using digital low resistance ohmmeter or by the Calculated Resistance Test Method

at the Contractor's option. The equipment and test procedures for the two methods are described herein.

2. Digital Low Resistance Ohmmeter Method:
 - a. Equipment and Materials:
 - (1) One Biddle Model 247001 digital low resistance ohmmeter or equal.
 - (2) One set of duplex helical current and potential handspikes, Biddle Model No. 241001, cable length as required.
 - b. Test Procedure: Measure the resistance of joint bonds with the low resistance ohmmeter in accordance with the manufacturer's written instructions. Use the helical handspikes to contact the pipe on each side of the joint, without touching the thermite weld or the bond. The contact area shall be cleaned to bright metal by filing or grinding and without any surface rusting or oxidation. Record the measured joint bond resistance on the test form described herein. Repair any damaged pipe coating in accordance with WIRE CONNECTIONS, this section.
3. Joint Bond Acceptance:
 - a. Joint bond resistance shall be less than or equal to the maximum allowable bond resistance values shown in Table 1.

Table 1			
Joint Type	Max. Allowable Resistance (Ohms)		
	One Bond/Joint	Two Bonds/Joint	Three Bonds/Joint
No. 2 AWG wire Bonds	0.000325	0.000162	0.000081
Flexible Coupling	0.000425	0.000212	0.000115

- b. The Contractor shall replace any joint bond that exceeds the allowable resistance. Replacement joint bonds shall be retested for compliance with the specified bond resistance.
 - c. Any defective joint bond discovered during energizing and testing shall be located, excavated, repaired, and backfilled by the Contractor.
4. Test Records: Records shall be made of each bonded pipeline during the test and submitted to the Engineer. These records shall include:
 - a. Description and location of the pipeline tested.
 - b. Starting location and direction of test.
 - c. Date of test.
 - d. Joint type.
 - e. Test current and voltage drop across each joint and calculated bond resistance (Calculated Resistance Method only).
 - f. Measured joint bond resistance (Digital Low Resistance Ohmmeter method only).

B. Insulated Joint Testing:

1. Test each insulating joint after assembly with a GAS Electronics Model 601 insulator tester or equivalent instrument in accordance with the manufacturer's written instructions. Conduct test before burial and coating of buried insulating flanges.
2. Contractor to replace damaged or defective insulation parts identified during testing.

3. Electrical Isolation is defined as a condition of being electrically isolated from other metallic structures (including, but not limited to, other piping, concrete reinforcement, casings, and other structures not intended to be cathodically protected) and the environment as defined in NACE Standard Practice SP0169.
 4. CONTRACTOR shall conduct additional insulating joint tests as required to assure that insulating flanges are not electrically shorted by other equipment or incidental contact with concrete reinforcement or other equipment during energizing and testing.
- C. Cathodic Protection System Energizing and Testing:
1. Initial Survey: Contractor shall conduct an initial potential survey at all test stations and measure the baseline (native) pipe-to-soil potential before connecting the anodes. Record GPS coordinates for each test station.
 2. Functional Testing:
 - a. Perform functional testing in presence of Engineer.
 - b. When construction of each cathodic protection station(s) is completed, notify Engineer that anodes are ready to be connected.
 - c. System deficiencies shall be repaired by Contractor.
 3. Energizing and Testing:
 - a. Performed by Engineer
 - b. General:
 - (1) Upon successful completion of functional testing, Engineer shall connect the galvanic anodes to the pipe through the shunt inside the test stations. Complete additional testing and adjustment to provide cathodic protection at all test points in accordance with NACE SP0169.
 - (2) Record baseline potentials at all test stations.
 - (3) Record ON and OFF potentials at all test stations by temporarily disconnecting the galvanic anodes from the pipe at the test station being evaluated.
 - (4) Measure and record galvanic anode current at each test station.
 4. Final Testing, Adjustment, and Report:
 - a. Performed by Engineer.
 - b. All test data shall be submitted in electronic file compatible with Microsoft Excel for Office, most recent version. The data shall be organized in tabular form with location descriptions and GPS coordinates.

END OF SECTION

SECTION 26 43 00
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SUMMARY

- A. This section describes the materials and installation requirements for Surge Protective Devices (SPDs) shown on the drawings and herein specified.

1.02 REFERENCES AND QUALITY ASSURANCE:

- A. IEEE C62.41, C62.45-2002, and C62.62-2010
- B. National Electrical Manufacturers Association (NEMA LS1)
- C. National Fire Protection Association (NFPA 70)
- D. Underwriters' Laboratories (UL 1449 3rd Ed. and 1283)

1.03 SUBMITTALS

- A. For each SPD device indicated:
 - 1. Product Data Sheets in NEMA LS-1 format - Publication for Low Voltage Surge Protection Devices (SPDs).
 - 2. Electrical/mechanical drawings showing unit dimensions, weights, installation instructions details, and wiring configuration.
 - 3. UL 1449 Edition 3 Listing Certificate.
 - 4. UL 1449 Edition 3 Suppressed Voltage Ratings.
 - 5. Independent let through voltage test results to ANSI IEEE C62.41 Cat C3 high energy impulse(20kV,10kA), B3 ring wave(6kV, 3kA).
 - 6. Copy of warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.
 - 7. Copies of Noise Rejection testing as outlined in NEMA LS1-1992 (R2000) Section 3.11. Noise rejection is to be measured between 50kHz and 100MHz verifying the devices noise attenuation. Must show multiple attenuation levels over a range of frequencies.

1.04 MANUFACTURES QUALIFICATIONS

- A. Manufacturers shall be ISO9000 certified.
- B. Manufacturers shall have been engaged in the design and manufacturing of such devices for at least ten (10) years.
- C. SPD shall be UL 1449 current edition listed, 20kA In Type 1 or Type 2 for use in UL 896A systems.

- D. The following manufacturers will be approved, provided they meet all specifications:
 - 1. ERICO Inc.
 - 2. Eaton equivalent
 - 3. Square D equivalent
 - 4. ABB
 - 5. Or prior approved equal.

1.05 WARRANTY

- A. The manufacture shall warrant the SPD against defects in material and workmanship for period of 10 years.

PART 2 PRODUCTS

2.01 GENERAL ELECTRICAL REQUIREMENTS

- A. Unit operating voltage- Refer to drawings for operating system voltage.
- B. Maximum continuous operating voltage (MCOV)- the MCOV shall not be less than 115% of the nominal system operating voltage.
- C. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode is not acceptable.
- D. SPD shall include L-G, L-N, and N-G modes of protection for wye systems at minimum. Delta power systems shall include L-L and L-G modes of protection at minimum.
- E. Nominal Discharge Current (In) - All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an In less than 20kA shall be rejected.
- F. Electrical Noise Filter - Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
 - 1. Type 2 units with filtering shall conform to UL 1283 5th Edition
 - 2. Type 1 units shall not contain filtering or have a UL 1283 5th Edition Listing.

- G. Internal Connections - No plug-in single-mode modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered and hardwired with connections utilizing low impedance conductors.
- H. Monitoring Diagnostics - Each SPD shall provide the following integral monitoring options:
- I. Remote Status Monitor- The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition. A reduction in capacity below the manufacturer's predetermined level shall operate an alarm contact.
- J. Surge Counter- The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of $50 \pm 20A$ occurs.
1. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
- K. The SPD shall have a maximum continuous operating voltage (MCOV) of:

POWER SYSTEM	MCOV (L-N)
Single phase (3W+G) 120/240 WYE	150V
Three phase (4W+G) 120/208 WYE	150V
Three phase (4W+G) 220/380 WYE	320V
Three phase (4W+G) 277/480 WYE	320V
Three phase (4W+G) 347/600 WYE	485V
Three phase (3W +/-G) 240V Delta	270V L-L
Three phase (3W +/-G) 480V Delta	550V

- L. The following Voltage Protection Rating (VPR) L-N, L-L For Delta, shall not be exceeded by the SPD:

Impulse Standard	120/240V	120/208V	220/380V	277/480V	240V Delta
ANSI/IEEE C62.41	<650V	<650V	<1000V	<1000V	<1000V
Cat B3	6kV	6kV	6kV	6kV	6kV
ANSI/IEEE C62.41	<1400V	<1400V	<1800V	<1800V	<1800V
Cat C3	20kV	20kV	20kV	20kV	20kV

2.02 SERVICE ENTRANCES, MCC, ATS, AND MAIN BREAKER OR DISTRIBUTION PANEL (UL TYPE 1&2)

- A. Hard wired MOV type SPD shall be installed at all AC service entrances of each building and/or as otherwise shown on the drawings. Installation on new equipment shall be integrated into the panel to reduce lead length.
- B. SPD shall be constructed with replaceable modules. However, they shall not utilize pluggable connection, due to the possibility of such devices to "weld" in place at higher surge currents.
- C. SPD shall incorporate 400kA 8/20 μ s aggregate surge current per mode, min.
- D. Independent certification shall be provided proving that the SPD meets a single shot surge rating of at least 120kA 8/20 μ s per mode, without failure of the fuse, disconnect or surge module. Bypassing of fusing/disconnects for purpose of this test is not acceptable.
- E. Each mode of the SPD shall be rated to exceed the life cycle testing of ANSI/IEEE C62.45 by withstanding least 10,000 operations at 3kA 8/20 μ s without failure.
- F. SPD shall be internally line fused and be UL Listed for use on circuits with short circuit fault currents of 200 kA. These fuses to be field replaceable with indication to warn if fuse has ruptured. Unit shall not require external fuses/breaker for connection.
- G. SPD shall be capable of withstanding multiple temporary over voltages per UL 1449 Ed 3 without failure or need to reset or replace modules/fuses.

2.03 LIGHTING PANELS (UL TYPE 2)

- A. SPD shall be installed at additional specific locations as shown on drawings or indicated on the panelboard schedules.
- B. SPD shall provide 60kA 8/20 μ s surge rating per mode, min.
- C. SPD shall be capable of withstanding multiple temporary over voltage per UL 1449 Ed 3 without failure or need to reset or replace modules/fuses.
- D. Independent certification shall be provided proving that the SPD meets a single shot surge rating of at least 60kA 8/20 μ s per mode, without failure of the fuse, disconnect or surge module. Bypassing fusing/disconnects for purpose of this test is not acceptable.
- E. Each mode of the SPD shall be rated to exceed the life cycle testing of ANSI/IEEE C62.45 by withstanding at least 10,000 operations at 6kV and 500A B3 Ringwave without failure.
- F. SPD shall be internally line fused and be UL Listed for use on circuits with short circuit fault current rating (SCCR) of 200 kA. These fuses to be field replaceable

with indication to warn if fuse has ruptured. Unit shall not require external fuses/breaker for connection.

- G. SPD shall be capable of withstanding multiple temporary over voltages per latest adopted UL 1449 edition without failure or need to reset or replace modules/fuses.

PART 3 EXECUTION

3.01 INSTALLATION

- A. SPDs shall be factory installed within the noted equipment.

END OF SECTION

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DIVISION 31 EARTHWORK

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SECTION 31 05 05
SITWORK DEMOLITION AND REMOVAL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. The removal and satisfactory disposal of pavement materials including concrete pavement, asphalt pavement, concrete driveways, sidewalks, curb and gutter, aggregate base, and geotextile fabric.
2. The removal and disposal of designated utility structures, pipes, and related appurtenances.
3. The removal of disposal of existing fence.

B. Related Sections include, but are not limited to:

1. Section 01 11 00 – Summary.
2. Section 01 31 00 – Coordination and Meetings.
3. Section 01 45 00 – Quality Requirements.
4. Section 01 50 00 – Construction Facilities and Temporary Controls.
5. Section 31 11 00 – Clearing and Grubbing.

1.02 PROTECTION

- A. Confine Work and stockpiling to within designated areas on the Owner's Actual Nameproperty as approved by Engineer. Leave undisturbed all pavement and utility appurtenances not indicated for removal or renovation.
- B. Maintain proper positive drainage during construction operations and through completion.

PART 2 PRODUCTS

NOT USED.

PART 3 EXECUTION

3.01 PREPARATION

- A. Inspect and record existing conditions on site and at adjacent areas prior to starting construction.
- B. Become familiar with required lines of removal and saw cutting.
- C. Identify underground utilities.

- D. Provide, erect, and maintain adequate barriers and warning lights.
- E. Protect and maintain survey monuments or any construction staking from disturbance during pavement removal.
- F. Keep streets, sidewalks, alleys, and driveways in usable condition; avoid property owner inconvenience insofar as practicable; do not trespass on private property.
- G. Commencement of this Section's Work means acceptance of existing conditions.

3.02 REMOVAL

- A. Saw cutting is required on all concrete and asphalt pavements. Pavement removal beyond the limits established in the notes on the Drawings shall be replaced at the Contractor's expense.
- B. Saw cut vertically full depth to obtain a clean break. Remove on straight lines approximately parallel or perpendicular to centerline or pavement.
- C. Remove curb and gutter where indicated on Drawings, or as necessary to accomplish Contractor's work. All additional curb and gutter removal must be approved by Engineer and Owner. Curb and gutter removal not specified and without proper approval shall be replaced at the Contractor's expense.
- D. Disturbances, breakage, or damage to areas not designated for removal shall be restored at Contractor's expense prior to final payment.
- E. Pavement removed beyond the limits established shall be replaced to the same specifications as the adjacent removal at Contractor's expense.
- F. Remove entire width of sidewalk if replacement width is less than sidewalk width.
- G. Remove abandoned utility structures, pipes, and related appurtenances where indicated on the drawings or encountered by new construction. Fill trenches with Type S1, S2, or Impervious Fill subsoil material, as specified in Section 31 05 13, and compact to a minimum of 95% of maximum dry density determined by ASTM D698 (Standard Proctor).
- H. Where abandoned pipes are to remain in place, plug all exposed ends with concrete.
- I. Where abandoned structures are to remain in place, plug all pipe penetrations with concrete and fill structure with Class 3 material, as specified in Section 32 11 23.

- J. Septic tank shall be removed by licensed contractors and in accordance with all ND Department of Health requirements. Contents of tank shall be removed and disposed of in accordance with local codes.

3.03 TOLERANCES

- A. Saw cut full depth of pavement to achieve a clean break. If required line of removal falls within 2 feet of an existing joint, adjust line of removal to be the existing joint.

3.04 DISPOSAL

- A. Remove broken pavement, pipes, utility structures, and appurtenances, and dispose of materials off site in Contractor furnished disposal area in a manner that is acceptable to local authorities and regulatory agencies.

END OF SECTION

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SECTION 31 05 13
SOILS FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Subsoil materials.
 - 2. Topsoil materials.
- B. Related Sections include:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Division 01 - General Requirements.
 - 3. Division 31 - Earthwork.
 - 4. Division 32 - Exterior Improvements.

1.02 SUBMITTALS FOR REVIEW

- A. See Section 01 33 00 - Submittal Procedures.
- B. Samples: In accordance with Section 01 45 00 - Quality Control.

1.03 QUALITY ASSURANCE

- A. Section 01 45 00 - Quality Control: Field Samples.
- B. Material Source: Provide materials from the same source throughout the Work. Change of source requires Engineer approval.

PART 2 PRODUCTS

2.01 SUBSOIL MATERIALS

- A. Subsoil: Uncontaminated excavated on-site material or imported borrow material. Graded free of lumps larger than 3 inches, rocks larger than 2 inches, and debris; non-plastic and inorganic material.
 - 1. Type S1: Fine sand and gravel, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Conforming to ASTM D2487 Group Symbol GM, GC, SM, SC, SP, SW, or dual symbol groups.
 - a. Inorganic On-site Native soils are generally considered Type S1
 - 2. Type S2: Silt, silty-clay, inorganic clays, and silts of low to medium plasticity and a maximum liquid limit of 40. Conforming to ASTM D2487 Group Symbol CL, ML, or dual symbols thereof.

3. Type S3: Plastic to highly plastic clays and clay-silt materials of medium to high plasticity Conforming to ASTM D2487 Group Symbol CH, and MH or dual symbols thereof.
4. Unsuitable soils: All frozen material, vegetation, trash, rocks, and concrete and bituminous chunks having a dimension exceeding 3 inches and otherwise not meeting the specifications of soil materials.

2.02 TOPSOIL MATERIALS

- A. Topsoil: Uncontaminated excavated on-site material or imported borrow material; Graded free of roots, rocks larger than 1 inch, subsoil, debris, large weeds, and foreign matter.
 1. Type S4: Imported or Re-used; Conforming to ASTM D2487 Group Symbol OL and OH and meets requirements of Section 02912 of the latest edition of the Utah Department of Transportation Standard Specifications for Road and Bridge Construction.

2.03 SOURCE QUALITY CONTROL

- A. Section 01 45 00 - Quality Control: Testing and analysis of soil material.
- B. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D698 and ASTM D6938.
- C. Testing and Analysis of Topsoil Material: Perform in accordance with ASTM D2487.
- D. Provide materials of each type from same source throughout the Work.
- E. Contractor shall coordinate with Engineer and Owner's independent geotechnical soil classification technician and laboratory to monitor soils installed. Contractor is responsible for scheduling and complying with geotechnical requirements.

PART 3 EXECUTION

NOT USED.

END OF SECTION

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 **GENERAL**

1.01 SUMMARY

A. Section includes:

1. Clear, grub, remove, and dispose of trees, stumps, and debris within the designated limits of the roadways, channels, easements, and other designated areas.

B. Related Sections include:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Division 1 – General Requirements.
3. Division 31 – Earthwork.

1.02 REGULATORY REQUIREMENTS

A. Conform to applicable codes and regulations for proper disposal of debris.

B. Conform to applicable codes for worker safety.

1.03 DEFINITIONS

A. Clear – Remove and dispose of trees, stumps, logs, limbs, sticks, vegetation, debris, and other material on the natural ground surface.

B. Grub – Remove and dispose of roots, buried logs, debris, organic matter, and other deleterious materials under the ground surface.

PART 2 **PRODUCTS**

2.01 MATERIALS

A. Construction Fencing: Construction fencing shall be orange plastic mesh, heavy duty, snow fencing fastened to metal or wood posts.

PART 3 **EXECUTION**

3.01 PREPARATION

A. Verify that existing plant life designated to remain is tagged or identified.

B. Beginning work of this Section means acceptance of existing conditions.

- C. Identify and furnish an area for storing or placing removed material prior to the commencement of Work in this Section.

3.02 PROTECTION

- A. Locate, identify, and protect utilities that remain from damage.
- B. Protect trees, plant growth, and features designated to remain, as final landscaping.
- C. Protect benchmarks, survey control points, and existing structures from damage.
- D. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades and from flooding site and surrounding area.
- E. Contractor shall repair or replace, to original condition or better, existing structures and improvements, flora, and landscaping damaged or injured during construction operations. Contractor shall understand the sensitive nature of working on or near developed property and shall endeavor to limit injury or damage both inside the limits of construction and outside the limits of construction.
- F. Protect existing trees and other vegetation indicated to remain from unnecessary cutting, breaking, skinning of roots, skinning and bruising of bark, smothering of trees, by stockpiling construction materials or excavated materials within the drip line, excess foot of vehicular traffic, or parking of vehicles within drip line.
- G. Protect wetlands, rivers, streams, and other waters of the state from all construction activities and contamination by erosion and runoff.
- H. Protect areas that have been finish graded from subsequent construction operations, traffic, and erosion. Remove, provide new, and compact as required, material contaminated by erosion and runoff

3.03 CLEARING

- A. Remove and dispose of trees, stumps, logs, limbs, sticks, vegetation, debris, and other material on the natural ground surface required for access to site and execution of work.

3.04 GRUBBING

- A. Grub the areas 2 ft below natural ground, within the limits of clearing, of all stumps, roots, buried logs, and all other underground obstructions.
- B. Stumps, roots, and non-perishable solid objects may remain in cleared areas where the embankment is:
 - 1. 2 ft or more above the natural ground.
 - 2. At least 2 ft away outside pavement and structures.

- C. Completely grub stumps and roots where a structure is to be constructed, piles are to be driven, or unsuitable material is to be removed.
- D. Backfill all stump holes, cuts, depressions, and other holes resulting from clearing and grubbing within areas to receive embankment.

3.05 DISPOSAL OF WASTE MATERIALS

- A. Remove all clearing and grubbing debris from the site in accordance with the Contract Documents and all permits and regulations. Burning shall not be allowed.

END OF SECTION

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SECTION 31 14 13
SOIL STRIPPING AND STOCKPILING

PART 1 **GENERAL**

1.01 SUMMARY

A. Section includes:

1. Protection of features not designated for removal.
2. Topsoil Removal.
3. Stockpiling of Materials.
4. Stockpile Cleanup.
5. Estimated Excess Material Volumes.

B. Related Sections include:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Division 01 – General Requirements.
3. Division 31 – Earthwork.

1.02 DESCRIPTION

- A. Limits of construction are shown on the Drawings. Excavation shall not be allowed outside of the limits of construction where shown on the Drawings.
- B. Materials may be temporarily stockpiled on the site within the limits of construction or where shown on the Drawings.
- C. Protect benchmarks and existing structures that are to remain from damage or displacement.

1.03 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the Work are as indicated.

1.04 DEFINITIONS

- A. Soil Testing Laboratory: Refers to a professional soils engineering firm with soil sampling and testing services that is independent from the Contractor.
- B. Structures: Existing and new construction, including slabs, buildings, footings, tanks, and other structural elements.

1.05 SITE CONDITIONS

- A. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.
- B. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.
- C. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.
- D. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.
- E. Do not commence construction of structure foundation until soil test results are confirmed.

PART 2 **PRODUCTS**

2.01 NOT USED

PART 3 **EXECUTION**

3.01 INSPECTION

- A. Contractor shall verify which native materials are suitable for reuse at the site. Provide testing data as required and keep materials separated.
- B. Notify Engineer of any unsuitable materials.

3.02 PROTECTION

- A. Protect all existing structures, trees, plantings, turf, and other facilities which are not scheduled for removal.

3.03 TOPSOIL REMOVAL

- A. Remove existing grass and 2" of soil inside fence. Protect existing tree roots.
- B. Protect all existing trees on site note shown for removal (typical). Do not excavate or fill in the dripline of existing trees to remain.

- C. All topsoil shall be stripped to full depth and stockpiled separately to be placed on top of finished grading and all disturbed areas not covered by hardscape such as pavement or gravel, structures or foundations, or landscape rock.
- D. Topsoil removal shall take place immediately before pipe installation and shall be replaced immediately following pipe installation on the parcels list below.
- E. Separate all debris, large roots, and rocks greater than 1-inch from the topsoil and remove from the site in accordance with all applicable Federal, State, and Local regulations to Contractor furnished site.
- F. Where trees are to be left standing, stop topsoil stripping a sufficient distance (at least the drip line) from a tree to prevent damage to main root system.

3.04 STOCKPILING OF MATERIALS

- A. Contractor may temporarily stockpile acceptable materials including topsoil, excess excavated, and delivered materials within the limits of construction where shown on the Drawings. Contractor shall obtain approval from Engineer before stockpiling excess materials.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.
- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
- E. Apply appropriate erosion control measures to stockpile areas.
- F. Avoid stockpiling in location of future levee or berm around the site.
- G. Contractor shall remove all excess stockpiles from the site prior to final completion of the project.

3.05 STOCKPILE CLEANUP

- A. Remove stockpile; leave area in a clean and neat condition. Grade site surface to prevent freestanding surface water.
- B. Temporary Stockpile Area:
 - 1. Contractor shall place material from excavations onsite in the area designated on the plans.

END OF SECTION

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SECTION 31 22 00
GRADING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes general requirements and procedures for site grading including, but not limited to, the following:
 - 1. Rough Grading
 - 2. Finish Grading
 - 3. Topsoil Placement
- B. Related Sections include:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Division 1 – General Requirements.
 - 3. Division 31 – Earthwork.

1.02 DESCRIPTION

- A. Contractor shall grade the site as shown on the Drawings. Contours and spot elevations indicate finished surface grades.
- B. Construct uniform slopes between contours and spot elevations.
- C. Limits of construction are shown on the Drawings. Excavation, placement of fill, or general grading shall not be allowed outside of the limits of construction where shown on the Drawings.
- D. Materials may be temporarily stockpiled on the site within the limits of construction or where shown on the Drawings.
- E. Perform finish grading and topsoil placement after waterline pressure testing and disinfection are completed.
- F. Protect benchmarks and existing structures that are to remain from damage or displacement.
- G. All earthwork shall be performed in a manner and sequence that will provide drainage and proper erosion control at all times.

1.03 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the Work are as indicated.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Subsoil and Topsoil Fills: As specified in Section 31 05 13 – Soils for Earthwork.
- B. Aggregate Fills: As specified in Section 32 05 16 – Aggregate for Exterior Improvements.
- C. Provide source testing data in accordance with Section 01 45 00 – Quality Control.

2.02 SOURCE QUALITY CONTROL

- A. Conduct the following tests on each material proposed for use prior to start of soils work. Refer to Section 01 45 00 – Quality Control, for source test requirements.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify structure and trench backfilling have been inspected.
- B. Verify subgrade base has been contoured and compacted.

3.02 PROTECTION

- A. Contractor shall conduct all grading operations within the limits of construction where shown on the Drawings, and within the designated grading limits as shown from contours and spot elevations.
- B. Protect all existing structures, trees, plantings, turf, and other facilities which are not scheduled for removal
- C. Provide proper erosion and sediment control for all grading operation.
- D. Repair disturbed areas and compact to required density prior to further work.
- E. Remove material contaminated by erosion and runoff, provide new material and compact.

3.03 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, and stones in excess of 2-inches in size. Remove subsoil contaminated with petroleum products.
- C. Scarify surface to depth of 3-inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

3.04 ROUGH GRADING

- A. Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth finish surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.
- B. Grade surface of fill under structures and slabs to required density, free of voids, and to required elevations.
- C. Rough grade areas adjacent to structure lines to drain away from structures and to prevent ponding or increase in soil lateral pressure on the structure.

3.05 FINISH GRADING

- A. Contractor shall provide the degree of finish grading that will be normally obtainable through the use of suitable equipment operated under favorable conditions and by an experienced operator. Deviations from the required tolerance shall be corrected by the Contractor at no additional cost to the Owner.

3.06 TOPSOIL PLACEMENT

- A. Place topsoil in areas where seeding and restoration is required to a nominal depth of 6-inches unless indicated otherwise on drawings.. Place topsoil during dry weather.
- B. Use imported topsoil as a supplement to stockpiled topsoil only when a 6-inch depth is unable to be maintained.
- C. Drag top-soiled areas to remove wheel tracks and provide a uniform texture and appearance.
- D. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade. Finish grades shall allow for proper drainage without ponding.
- E. Remove roots, weeds, rocks, and foreign material while spreading.
- F. Manually spread topsoil close to plant life and buildings to prevent damage.
- G. Lightly compact placed topsoil.
- H. Remove surplus subsoil and topsoil from site. Contractor shall pay for loading, hauling, and spreading of all excess topsoil materials removed from the site or placed and spread on-site by direction of Owner or Engineer.
- I. Contractor shall pay for additional topsoil that is required at the site, including providing transporting and placing topsoil.

J. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.07 TOLERANCES

A. Top of Topsoil: +/- 1 inch.

END OF SECTION

SECTION 31 23 13
SUBGRADE PREPARATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Scarifying, compacting and shaping the earth subgrade.
2. Perform subgrade preparation on all areas to receive concrete pavement, bituminous pavement, aggregate base course, and/or aggregate surface course and utility trenches.

B. Related Sections:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Division 1 – General Requirements.
3. Division 31 – Earthwork.

PART 2 PRODUCTS

2.01 OTHER MATERIALS

- A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to approval of the Engineer.
- B. Suitable Soil Materials: On-Site excavated material or imported material meeting subsoil classification S1 defined in Section 31 05 13 – Soils for Earthwork.

PART 3 EXECUTION

3.01 GENERAL

- A. Subgrade Preparation shall consist of producing a firm and stable subgrade prior to placement of the surface or base course.

3.02 SUBGRADE PREPARATION

- A. The Contractor shall compact and shape the subgrade for its full width as may be necessary to produce, at the time the base course is placed, the required density in the upper 12-inches of the base and the required grade and cross-section.
- B. Contractor shall be responsible for drying the subgrade soil or applying water as may be necessary to obtain the required density. Contractor shall also be

responsible for grading the Work area and providing drainage so that accumulating water will drain away from the subgrade.

1. After general site stripping and excavation has been completed, exposed soils should be proof-rolled with a tandem axle dump truck loaded to at least 25-ton weight. Truck shall traverse the structure and pavement footprint to detect areas of loose or soft soils as observed by the geotechnical engineer or his representative.
 2. Loose or soft soils shall be defined as soils exhibiting "excessive rutting" from the truck tires (approximately 1-inch) wheel rut depth.
 3. Soft or unstable soils encountered during proof-rolling should be over-excavated and replaced with Structural Fill or Untreated base Course.
 4. The over-excavation depth should extend to competent soil as assessed by the geotechnical engineer.
 5. Over-excavated areas should be backfilled with Structural Fill or Untreated Base Course in accordance with SECTION 32 05 16 - AGGREGATES FOR EXTERIOR IMPROVEMENTS.
 6. Following proof-rolling, the exposed subgrade soils should be scarified to a minimum depth of 6 inches, moisture-conditioned to near optimum moisture content (+/- 2 percent of optimum) and compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D698 (Modified Proctor).
- C. The finished subgrade surface shall be smooth and uniform and shall not rut, shove, flex, or displace when any construction equipment is placed on it.
- D. The required grade and cross-section for subgrades shall consist of a smooth subgrade surface that conforms to the prescribed elevations for the particular subgrade being prepared, prior to constructing an additional course thereon. The required grade and cross-section for rough graded surfaces shall consist of a smooth graded surface that conforms to the prescribed elevations for that particular rough grade being prepared. The prescribed elevation for any point on the subgrade or rough graded surfaces shall be as determined from the grades staked by the Engineer.
- E. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations, vehicular traffic, or weather conditions.
- F. Subgrade preparation shall apply to all mat foundations, pipe trenches, concrete slabs, paved and graveled areas, including roads, driveways, parking areas, and sidewalks.
- G. Testing requirements for subgrade preparation shall be as follows:

1. Shall conform to requirements of Section 01 45 00 – Quality Control.

3.03 SPECIAL REQUIREMENTS

- A. Only hand-operated compaction equipment should be used within 5-feet of walls.
- B. Final subgrade elevation improvements for mat foundations should be smoothed using a vibratory plate, care shall be taken to prevent pumping of subgrade.

3.04 TOLERANCES

- A. Finish subgrade or rough graded surfaces shall not deviate by more than 1-inch from the required section and grade.

END OF SECTION

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SECTION 31 23 16
EXCAVATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Requirements for Excavation.
2. Subgrade Preparation.
3. Common Excavation.
4. Estimated Excavation Quantities.
5. Disposal.

B. Related Sections:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirement.
3. Division 31 – Earthwork.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM).

1.03 SUBMITTALS

A. Submit the following in accordance with Section 01 33 00 – Submittal Procedures:

1. Test Results: Prior to start of work, submit written reports for each material sampled and tested. Include project identification, date of report, name of contractor, name of testing laboratory, source of material, manufacturer and brand name for manufactured products, specification requirements for each material, and corresponding test results.
 - a. Tests must have been taken no more than 180-calendar days before Notice to Proceed.
2. Product Data: Information on manufactured products indicating compliance with requirements of this Section.

1.04 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.
- B. Structures: Existing and new construction, including slabs, buildings, tanks, and structural elements and systems.

- C. Acceptable Materials: Material that will provide for the indicated soil bearing capacity, soil densities, material requirements and that, in the opinion of soil testing laboratory, will not be subject to future decomposition, settlement, subsidence, expansion and are otherwise of the required soil type.
- D. Unsuitable Materials: Material that will not provide for the indicated soil bearing capacity and soil densities and that in the opinion of the soil testing laboratory will be subject to future decomposition, settlement, subsidence, expansion, and are otherwise not of the required soil type.
- E. Soil Testing Laboratory: Refers to professional soils engineering firm with soil sampling and testing services and that is independent from the Contractor. The soil testing laboratory's engineer shall be licensed in the State of Utah.
- F. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, topsoil removal, excavation to grade, and scarification and compaction of subgrade.

1.05 SITE CONDITIONS

- A. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.
- B. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.
- C. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.
- D. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.
- E. Do not commence construction of structure foundation until soil test results are confirmed.

1.06 CONVENTIONAL QUALITY ASSURANCE

- A. Source Quality Control Testing: Retain the services of an independent soil testing laboratory for Source Quality Control sampling and testing.

- B. Materials and installed work may require testing and retesting, as required by Engineer, at any time during progress of work.
- C. Allow free access of testing laboratory to material stockpiles and facilities at all times.
- D. Tests including retesting of rejected materials and installed work shall be at Contractor's own expense unless otherwise indicated.
- E. See Section 01 45 00 – Quality Control, for additional requirements.

1.07 SEQUENCING AND SCHEDULING

- A. Additional excess material shall be stockpiled in accordance with Section 31 14 13 – Soil Stripping and Stockpiling.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Stockpile delivered materials and excavated materials at locations approved by Owner until required for backfill or fill. Place, grade, and shape stockpiles for drainage.
- B. Store materials in manner that will not impose additional loading and soil pressure on excavation limits and structures.

1.09 PAYMENT

- A. All earth rock, peat, muck and all other excavation, removal and disposal required; erosion control, sheeting, shoring and bracing; fill and backfill; placement compaction, grading, source quality control testing, and all other work required under this Section shall be considered incidental to the Project and no claim for compensation or extra work will be accepted.
- B. No claim for additional payment will be accepted for excavation and fill for all structures required for removal of unsuitable material of up to 3-feet below bottom of foundation or 1-foot below noted structural fill or backfill or 1-foot below minimum excavation limit as noted on Drawings, whichever results in the greater excavation and fill.
- C. No claim for additional payment will be accepted for repairs made to subgrade due to weather related problems.

1.10 FIELD MEASUREMENTS

- A. Survey benchmarks, control points, and intended elevations for the Work are as shown on the Drawings or will be provided by the Engineer.

1.11 COORDINATION

- A. Coordinate work under provisions of Section 01 31 00 – Coordination and Meetings.
- B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.
- C. Contractor shall excavate for structures, pipe, and utilities at grades shown on the Drawings. Careful consideration shall be given to whether elevations shown are invert elevations or centerline elevations, Contractor shall make appropriate adjustment depending on elevation shown.

PART 2 PRODUCTS

2.01 EXCAVATION MATERIALS

- A. See Section 31 05 13 – Soils for Earthwork, for materials specifications.

2.02 SOURCE QUALITY CONTROL

- A. See Section 31 23 23 – Fill and Backfill, and Section 01 45 00 – Quality Control, for material quality testing requirements.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine project site and conditions under which work of this Section is to be performed.
- B. Contractor shall verify which native materials are suitable for reuse at the site. Provide testing data as required and keep materials separated.
- C. Notify Engineer of any unsuitable materials.
- D. Do not over excavate without authorization from Engineer.

3.02 PREPARATION

- A. An OSHA approved competent person shall review the above-mentioned soil classification in the field. Excavations shall be OSHA compliant. Excavation safety is the responsibility of the Contractor. All excavations greater than 20-feet in depth shall be designed by a registered Professional Engineer.
- B. Protection
 - 1. Locate existing utilities in areas of work. Protect utilities that are to remain.
 - 2. Protect structures from damage and from damage caused by groundwater, surface water, flood or floatation forces, lateral movement, settlement,

undermining, washout, and other undesirable conditions created by the work.

- a. Maintain drainage when drainage ways are obstructed by earthwork and related operations.
 3. Protect areas beyond construction zone with erosion control system.
 4. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when allowed by utility owner and then only after acceptable temporary utility services have been provided.
 - a. Provide temporary services, complying with Federal, State and local laws and regulations, and as acceptable to Owner, during any interruptions.
 5. Maintain full access to structure exits and entrances, fire hydrants, street crossings, sidewalks, and other points as designated by Owner to prevent significant interruption of accessibility.
 6. Do not bring explosives on site or use in work.
 7. Maintain excavations and stockpiles to prevent caving, heaving, slides, and increased soil pressures on adjacent and underlying structures.
 8. Maintain existing site drainage ways or provide new paths of drainage for site as required to perform earthwork.
- C. Contractor is responsible for proper moisture conditioning of soils out of recommended moisture range as specified in section 01 45 00.
1. Dry subgrade: Add water, then mix to make moisture content uniform throughout.
 2. Wet subgrade: Aerate material by blading, disking, harrowing, or other methods to hasten drying process.
- D. Excavation support: Install and maintain, as specified in Section 31 41 00 – Shoring, shoring as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

3.03 PROTECTION

- A. Locate existing utilities in areas of work. Protect utilities that are to remain.
- B. Protect structures from damage and from damage caused by groundwater, surface water, flood or floatation forces, lateral movement, settlement, undermining, washout, and other undesirable conditions created by the work.
 1. Maintain drainage when drainage ways are obstructed by earthwork and related operations.

- C. Do not interrupt existing utilities serving facilities occupied and used by Owner or others, except when allowed by utility owner and then only after acceptable temporary utility services have been provided.
 - 1. Provide temporary services, complying with Federal, State and local laws and regulations, and as acceptable to Owner, during any interruptions.
- D. Protect areas that have been finish graded from subsequent construction operations, traffic, and erosion.
 - 1. Install erosion control protection along perimeter of unfinished areas.
- E. Do not bring explosives on site or use in work.
- F. Maintain excavations and stockpiles to prevent caving, heaving, slides, and increased soil pressures on adjacent and underlying structures.
- G. Repair disturbed areas and compact to required density prior to further work.
- H. Remove material contaminated by erosion and runoff, provide new material and compact.

3.04 COMMON EXCAVATION

- A. Excavate designated areas to the proposed subgrade elevations indicated on the Drawings.
- B. Contractor shall advise Engineer immediately if any unsuitable materials are encountered during excavation. Unsuitable materials shall be reasonably separated from unsuitable materials and shall be considered surplus material at no additional cost to the Owner.
- C. If Contractor encounters excess excavation materials which meet the requirements of common fill as specified herein, Contractor may use those materials as common fill. Contractor shall verify with soils testing laboratory suitability of the use of on-site material.

3.05 DISPOSAL

- A. Contractor shall remove excess soil and unsuitable material such as muck, organic matter, trash, and refuse from the site and dispose of said material according to applicable Federal, State, and local regulations. No additional payment will be provided for off-site disposal.

END OF SECTION

SECTION 31 23 19
DEWATERING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Provision and maintenance of an adequate dewatering system to remove and dispose of all surface and groundwater entering the excavation, trenches, and other parts of the Work.

1.02 PERMITS AND LICENSES

- A. The Contractor shall be responsible for obtaining all necessary permits as related to dewatering and water discharge and to comply with all stipulations of such permits.
- B. A permit may be required for construction dewatering from the appropriate watershed district and/or the State.

PART 2 PRODUCTS

2.01 NOT USED.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor may use any method or combination of methods for dewatering; however, all dewatering methods and equipment which, in the opinion of the Engineer, are ineffective shall be abandoned, improved, replaced or otherwise altered to obtain effective dewatering.
- B. The Contractor shall provide all power, pumps, materials, and equipment necessary, and shall be responsible for disposing of the water pumped from the excavation or pond in a manner that will not interfere with other Work within the area and will not damage public or private property. The discharge of pumped water offsite is prohibited. The Contractor will be held responsible for the condition of any pipe, conduit, ditch, channel or natural watercourse utilized for drainage purposes. All erosion, sediment, or other adverse results of its use shall be repaired at Contractor's expense.

3.02 WATER QUALITY CONTROL

- A. All points of concentrated dewatering discharge shall be visually inspected daily by the Contractor to determine that no eroded materials from the Site are being deposited in any natural drainage ways or surface waters.

END OF SECTION

SECTION 31 23 23
FILL AND BACKFILL

PART 1 **GENERAL**

1.01 SUMMARY

- A. Section includes general requirements and procedures for site grading including, but not limited to, the following:
 - 1. Filling, Backfilling, and Compacting.
- B. Related Sections include, but are not limited to:
 - 1. General Conditions.
 - 2. Supplementary Conditions.
 - 3. General Requirements.
 - 4. Division 01 – General Requirements.
 - 5. Division 31 – Earthwork.

1.02 REFERENCES

- A. American Public Works Association (APWA) Utah Chapter Manual of Standard Specifications, latest Edition.

1.03 DESCRIPTION

- A. Limits of construction are shown on the Drawings. Placement of fill shall not be allowed outside the limits of construction unless location is authorized by the Owner.
- B. Materials may be temporarily stockpiled on the site within the limits of construction, or where shown on the Drawings.
- C. Excess materials shall be stockpiled on site at locations authorized by Owner.
- D. Protect benchmarks and existing structures that are to remain from damage or displacement.

1.04 DEFINITIONS

- A. Suitable Material: Material that will provide the indicated required soil bearing capacity, soil densities, material requirements or, in the opinion of the soils testing laboratory, will not be subject to future decomposition, subsidence, settlement, or expansion.
- B. Structures: Existing and new construction, including slabs, buildings, footings, tanks, and other structural elements.

- C. Relative Compaction:
1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D698.
 2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by the Engineer.
- D. Optimum Moisture Content:
1. Determined in accordance with ASTM standard specified to determine maximum dry density for relative compaction.
 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.
- E. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.
- F. Complete Course: A course or layer that is ready for next layer or next phase of Work.
- G. Lift: Loose (uncompacted) layer of material.
- H. Well-Graded:
1. A mixture of particle sizes with not specific concentration or lack thereof of one or more sizes.
 2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
 3. Use to define material type that, when compacted, produces a strong and relative incompressible soil mass free of detrimental voids.
- I. Influence Area: Are within planes sloped downward and outward at 60-degree angle from horizontal measured from:
1. 1-foot outside outermost edge at base of foundations or slabs.
 2. 1-foot outside outermost edge at surface of roadways or shoulder.
 3. 0.5-foot outside exterior of spring line of pipes.
- J. Borrow material: Material from required excavations or from designated borrow areas on or near Site.
- K. Select Backfill Material: Materials available on-site that Engineer determines suitable for specific use.
- L. Imported Material: Materials obtained from sources offsite, suitable for specified use.

1.05 SITE CONDITIONS

- A. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.
- B. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.
- C. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.
- D. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.
- E. Do not commence construction of structure foundation until soil test results are confirmed.

1.06 SEQUENCING AND SCHEDULING

- A. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03 30 00 – Cast-In-Place Concrete. Obtain Engineer's acceptance of concrete work and attained strength prior to placing backfill.

1.07 PAYMENT

- A. All excavation, removal, and disposal of earth, peat, muck, and other materials; erosion control; sheeting, shoring, and bracing; fill and backfill, placement, compaction, grading, source quality testing; stockpiling; and all other work under this Section shall be considered incidental to the Project and no claim for additional compensation of extra work will be accepted.
- B. No claim for additional payment will be accepted for excavation and fill for all structures and improvements required for removal of unsuitable material up to two-feet (2') below bottom of proposed piping invert elevation or one-foot (1') below bottom of noted structural fill or one-foot (1') below minimum excavation limit as noted on the Drawings, whichever results in the greater excavation and fill.
- C. No claim for additional payment will be accepted for repairs made to subgrade due to weather related items.

1.08 FIELD MEASUREMENTS

- A. Verify that survey benchmark, control point, and intended elevations for the Work are as shown on Drawings or will be provided by the Engineer.

1.09 FIELD QUALITY CONTROL

- A. Section 01 45 00 – Quality Control.
- B. Compaction testing will be performed in accordance with ASTM D698, and ASTM D2922.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to Owner.

1.10 COORDINATION

- A. Coordinate work under provisions of Section 01 31 00 – Coordination and Meetings.
- B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.
- C. Contractor shall excavate for piping and utilities at grades shown on the Drawings. Careful consideration shall be given to whether elevations shown are invert elevations or centerline elevations, Contractor shall make appropriate adjustment depending on elevation shown.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Backfill around Structures: Backfill shall be as indicated on the Construction Drawings. Structures shall utilize Type S1 materials as specified in Section 31 05 13 – Soils for Earthwork, unless otherwise indicated as granular materials which are specified in Section 32 05 16 – Aggregate for Exterior Improvements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Notify utility company to locate utilities.
- C. Protect plant life, lawns, and other features remaining as a portion of final landscaping.
- D. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

- E. Maintain and protect above and below grade utilities that are to remain.
- F. Contractor shall verify which native materials are suitable for reuse as granular foundation, bedding, encasement, and backfill material at the site. Provide testing data as required and keep materials separated.
- G. Notify Engineer of any unsuitable materials or poor subgrade conditions.
- H. Notify Engineer when structure or tank is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
- I. Dewater excavations during backfilling at no cost to Owner.
- J. Dewater and dry saturated materials suitable for backfill at no cost to Owner.
- K. Compact subgrade to density requirements for subsequent backfill materials.
- L. Cut out soft areas of subgrade not capable of compaction in-place. Backfill with Structural Fill or Untreated Base Course beneath pavement or structures and compact to density equal to or greater than requirements for subsequent fill material. Type S1 or S2 fill materials may be used outside of pavement and structure areas.
- M. Identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.

3.02 STOCKPILING OF MATERIALS

- A. Stockpile according to Section 31 14 13 – Soil Stripping and Stockpiling.

3.03 FILLING, BACKFILLING, AND COMPACTING

- A. Surface compact excavations prior to installing fill material.
- B. Proof roll subgrade areas, where noted with, as a minimum, a tandem axle dump truck loaded to at least 25-ton weight. Truck shall traverse the structure footprint to detect areas of loose or soft soils. Loose or soft soils shall be defined as soils exhibiting “excessive rutting” from the truck tires (approximately 1-inch) wheel rut depth.
- C. Do not place material on muddy surfaces, frozen ground or on materials containing frost or ice.
- D. Do not place fill required below structures until soil conditions encountered have been approved by special inspector.
- E. Slope grade away from structures minimum 2-inches in 10-feet, unless noted otherwise.

- F. Do not place material on or in water.
- G. Do not proceed with backfilling of excavations until completion of the following:
 - 1. Observation, testing, approval, and recording of locations of underground utilities.
 - 2. Removal of concrete formwork.
 - 3. Removal of shoring, bracing, other protection systems, and backfilling and compaction of voids left by their removals.
 - 4. Removal of unsuitable materials, construction related debris, and excess materials.
 - 5. Walls, including interior walls that brace exterior walls and intermediate floors and roof construction is installed, cured, and obtained required 28-day compressive strength.
 - 6. When existing in-place soil materials are of density less than that specified, but the soil material is acceptable, perform removal, filling, disking of ground surface, moisture-conditioning to within acceptable limits of the optimum moisture content, and compact to provide specified density and bearing capacity as recommended by soils testing laboratory.
- H. Placement and Compaction
 - 1. Place materials in compacted layers of thickness required to obtain specified soil densities. Layers shall not exceed 8-inches in loose depth for cohesive and cohesion-less soil material, respectively, compacted by heavy compaction equipment and not more than 8-inches in loose depth for cohesive and cohesion-less soil materials, respectively, compacted by hand operated tampers unless soil density tests substantiate specified densities will be obtained when material is placed in thicker lifts.
 - 2. Place material in lifts uniformly to the same approximate elevation, not exceeding the final grade height, in manner required to prevent creation of unbalanced soil lateral pressures, wedging action of materials and soil pressures that exceed the design lateral soil conditions and to prevent damage to the structure.
 - 3. Moisten or aerate each layer to the extent required to obtain the optimum moisture content required for the indicated compaction density. Prevent free water from appearing on surface during or subsequent to compaction operations.
 - 4. Remove and replace with acceptable material or scarify and air dry otherwise acceptable soil material that is too wet to obtain specified soil density. Assist drying by disking, harrowing, or pulverizing, until moisture content is reduced to value required for compaction.
 - 5. Compact each layer to the required density specified for each area classification. Hand tamp or utilize hand operated vibratory equipment

when required to compact material placed immediately adjacent to walls within 5-feet.

6. Do not place additional layers until density of each layer in place complies with compaction requirements. Perform corrective work as required to obtain required density. Cost associated with correction work and retesting at failed test locations shall be at Contractor's expense.
7. At door stoops place sand cushion to cross-section indicated on Drawings.

3.04 REPLACING OVER-EXCAVATED MATERIAL

- A. Replace excavation carried below grade lines shown or established by the Engineer as follows:
 1. Beneath Existing Footings: Concrete of strength equal to respective footing.
 2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
 3. Beneath Slabs on Grade: Structural fill.
 4. Permanent Cut Slopes (Where overlying area is not to receive fill or backfill):
 - a. Flat to Moderate Steep Slopes (3:1 or flatter): Type S1 fill.
 - b. Steep Slopes:
 - 1) Correct over-excavation by transitioning between overcut areas and designed slope adjoining areas, providing such cutting does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities or completed Work.
 - 2) Backfilling over-excavated areas is prohibited, unless in Engineer's opinion, backfill will remain stable, and over-excavated material is replaced as compacted common fill.

3.05 PLACING FILL OVER GEOSYNTHETICS

- A. General:
 1. Place fill over geosynthetics with sufficient care so as not to damage them.
 2. Place fill only by back dumping and spreading only.
 3. Dump fill only on previously placed fill.
 4. While operating equipment, avoid sharp turns, sudden starts and stops that could damage geosynthetics.
- B. Hauling: Operate hauling equipment with a minimum 3-feet of covering.
- C. Spreading:
 1. Spreading equipment shall be track mounted low ground pressure, D-3 or lighter.
 2. Operate spreading equipment on minimum of 12-inches of fill.

3. Spread fill in same direction as un-seamed overlaps to avoid separation.
4. Limit distance material falls to maximum of 2-feet.
5. Flatten wrinkles in direction of spreading.
6. Maintain proper overlap of un-seamed.
7. Avoid overstressing material and seams.

D. Geosynthetics Damage:

1. Mark punctures, tears, or other damage, so repairs can be made.
2. Clear overlying fill as necessary to repair damage.

3.06 COMPACTION REQUIREMENTS

- A. Compact materials as required in Section 01 45 00 – Quality Control.
- B. Contractor shall re-compact all areas represented by failed density tests at their own expense.

3.07 TOLERANCES

- A. Finished Grade:
 1. +/- 1 inch upon completion of settlement in ditches, berms, and lawn areas.
 2. +/- 1 inch upon completion of settlement in roadways and driveways.
- B. All areas that receive fill or backfill shall be kept within settlement tolerances through the warranty period.

3.08 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 50 00 – Temporary Facilities and Controls.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.09 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within the correction period stipulated in the Supplementary Conditions.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30-days after notice from the Engineer or Owner, or sooner if required by Engineer or Owner, depending on the critical nature of the settlement.

3.10 SCHEDULE

A. Beneath Landscaped Areas:

1. Type S1 or S2, to a minimum of 6-inches and a maximum of 18-inches below finish grade, compacted as specified in Section 01 45 00 – Quality Control.

B. Beneath Concrete Slabs on Grade and Adjacent to Concrete Structures and for all pipe installations:

1. Material: As indicated on the Construction Drawings, Structural Fill or Untreated Base Course per Section 32 05 16 – Aggregate for Exterior Improvements or Fill Type S1 per Section 31 05 13 -Soils for Earthwork when approved by Geotechnical Engineer, placed in compliance with the Drawings.
2. Compacted Thickness: Equal, continuous layers not exceeding 8-inches compacted thickness. In the upper 12-inches of soil below the pavement place compacted lifts no greater than 8-inches.
3. Compaction: As specified in Section 01 45 00 – Quality Control.

C. Fill to Correct Over-excavation:

1. Structural Fill or Untreated Base Course per Section 32 05 16 – Aggregate for Exterior Improvements or Fill Type S1 per Section 31 05 13 -Soils for Earthwork when approved by Geotechnical Engineer, and as indicated on the Construction Drawings, flush to required elevation, compacted as specified in Section 01 45 00 – Quality Control.

D. Subgrade Preparation:

1. See Section 31 23 13 - Subgrade Preparation

E. Beneath Concrete or Asphalt Paving :

1. Materials: Structural Fill or Untreated Base Course per Section 32 05 16 – Aggregate for Exterior Improvements or Fill Type S1 per Section 31 05 13 -Soils for Earthwork when approved by Geotechnical Engineer.
2. Compact Subsoil as specified in Section 01 45 00 – Quality Control.

F. Topsoil Fill:

1. See Section 31 05 13 – Soils for Earthwork.

END OF SECTION

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SECTION 31 23 33
TRENCHING AND BACKFILLING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Excavating trenches for utilities.
 - 2. Compacted bedding and fill of utilities to subgrade elevations.
 - 3. Backfilling and compaction requirements for trenches.
- B. Related Sections include, but are not limited to:
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 – General Requirement.
 - 3. Division 31 – Earthwork.

1.02 DEFINITIONS

- A. Utility: Any buried pipe, duct, conduit, or cable.
- B. Soil Testing Laboratory: Refers to a professional soils engineering firm with soil sampling and testing services that is independent from the Contractor.
- C. Suitable Material: Material that will provide the indicated required soil bearing capacity, soil densities, material requirements or, in the opinion of the soils testing laboratory, will not be subject to future decomposition, subsidence, settlement, or expansion.
- D. Structures: Existing and new construction, including slabs, buildings, footings, tanks, and other structural elements.

1.03 SITE CONDITIONS

- A. Data indicated on the subsurface conditions are not intended as representations, warranties of accuracy, or continuity between soil borings. It shall be expressly understood that Owner and Engineer shall not be responsible for interpretations or conclusions drawn from these reports by the Contractor. The information is made available for the convenience of the Contractor and is in no way, shape, or form considered a part of this Contract.
- B. Contractor shall determine to Contractor's own satisfaction the nature and location of subsurface obstacles and the nature of soil and water conditions which will be encountered during the work.

- C. Contractor may perform additional test borings or other exploratory operations at Contractor's own expense. Contractor shall make arrangements for any additional soils investigation with Owner.
- D. No claim for additional payment will be accepted due to the nature of subsurface conditions in which the work is to be performed.
- E. Do not commence construction of structure foundation until soil test results are confirmed.

1.04 ADDITIONAL PAYMENT

- A. All excavation, removal, and disposal of earth, peat, muck, and other materials; erosion control; sheeting, shoring, and bracing; fill and backfill, placement, compaction, grading, source quality testing; stockpiling; and all other work under this Section shall be considered incidental to the Project and no claim for additional compensation of extra work will be accepted.
- B. No claim for additional payment will be accepted for excavation and fill for all structures and improvements required for removal of unsuitable material up to two (2) feet below bottom of proposed piping invert elevation or one (1) foot below bottom of noted structural fill or one (1) foot below minimum excavation limit as noted on the Drawings, whichever results in the greater excavation and fill.
- C. No claim for additional payment will be accepted for repairs made to subgrade due to weather related items.

1.05 FIELD MEASUREMENTS

- A. Verify that survey benchmark, control point, and intended elevations for the Work are as shown on Drawings.

1.06 COORDINATION

- A. Coordinate work under provisions of Section 01 31 00 – Coordination and Meetings.
- B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.
- C. Contractor shall excavate for piping and utilities at grades shown on the Drawings. Careful consideration shall be given to whether elevations shown are invert elevations or centerline elevations, Contractor shall make appropriate adjustment depending on elevation shown.

PART 2 PRODUCTS

2.01 GENERAL

- A. Granular materials provided for foundation, bedding, encasement, and backfill or other purposes shall consist of any natural or synthetic mineral aggregate such as sand, gravel, crushed rock, or slag, which shall meet the meet the gradation requirements specified herein for each specific use.
- B. Granular materials provided for foundation, bedding, encasement, or backfill use shall be classified by use in accordance with the following requirements.

2.02 PIPE FOUNDATION

- A. Pipe foundation shall be placed below the bottom of the pipe bedding as replacement for unsuitable or unstable soils to provide better pipe support.
- B. Pipe foundation material shall be Structural Fill or Granular Foundation Rock in areas of high groundwater aggregate material as specified in Section 32 05 16 – Aggregate for Exterior Improvements.

2.03 PIPE BEDDING

- A. Pipe bedding shall be placed below the pipe invert, prior to pipe installation to facilitate proper shaping and achieve uniform pipe support. Minimum depth as indicated on the Construction Drawings.
- B. Pipe bedding material shall meet the requirements of Type A5 within Section 32 05 16 – Aggregate for Exterior Improvements, and as indicated on the Construction Drawings.

2.04 PIPE HAUNCHING

- A. Haunching Material shall be placed below the pipe springline to pipe bedding, following pipe installation to facilitate proper uniform pipe support. Minimum depth as indicated on the Construction Drawings.
- B. Haunching material shall meet the requirements of Type A5 within Section 32 05 16 – Aggregate for Exterior Improvements, and as indicated on the Construction Drawings.

2.05 PIPE ENCASEMENT

- A. Pipe encasement shall be placed above springline of pipe to 18" above top of pipe, after pipe installation, for protection of the pipe.

- B. Pipe encasement material shall meet the requirements of Type A5 within Section 32 05 16 – Aggregate for Exterior Improvements, and as indicated on the Construction Drawings.

2.06 GRANULAR BACKFILL

- A. Beneath basins or other structural construction shall meet the requirements of Structure Fill within Section 32 05 16 – Aggregate for Exterior Improvements, and as indicated on the Construction Drawings.

PART 3 EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, maintain, and protect utilities that remain from damage.
- C. Notify utility company to locate utilities.
- D. Protect plant life, lawns, and other features remaining as a portion of final landscaping.
- E. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Maintain and protect above and below grade utilities that are to remain.
- G. Contractor shall verify which native materials are suitable for reuse as granular foundation, bedding, encasement, and backfill material at the site. Provide testing data as required and keep materials separated.
- H. Notify Engineer of any unsuitable materials.
- I. Dewater trench and structure excavations at no additional cost to Owner.

3.02 EXCAVATING

- A. Excavate topsoil in accordance with Section 31 14 13 – Soil Stripping and Stockpiling.
- B. Excavate trench to alignment and grade as required to meet foundation and bedding requirements as specified. Trench shall be centered on pipe alignment and no more than 100-feet of trench should be excavated in advance of pipe laying operations.
- C. The trench width may vary and depend on the depth of trench, the diameter of pipe to be laid, and the nature of the material to be excavated, but in any case, shall

be of ample width to allow the pipe to be laid and joined properly and the backfill to be placed and compacted properly. The minimum bottom width of unsheeted trench shall be 18-inches. The maximum clear width of trench at the top of the pipe shall be not more than 32-inches greater than the outside diameter of the pipe for pipes 30-inches diameter and larger, or 18-inches greater for pipe under 30-inches in diameter. Wider trench widths at the top of the pipe shall be subject to approval by Engineer. The width of the trench at the ground surface shall be kept to a minimum to prevent unnecessary disruption of service structures.

- D. If the trench width at the pipe zone is excavated to a greater width than the maximum, the Engineer may require the Contractor to provide a higher class of bedding and/or higher strength pipe that that required by the Contract Documents in order to satisfy pipe design requirements. In such case, no additional compensation shall be made for the higher-class bedding or higher strength pipe.
- E. Trench excavation shall be made by open cut methods. Trench sides shall be as vertical as possible and the trench shall be braced, sheeted, and drained such that the work may be performed safely in accordance with OSHA requirements.
- F. Sheet piling, shoring, and bracing shall be put in place and maintained as required due to soil stability or site constraints. Shoring, sheet piling, and bracing shall be provided to prevent disturbance or settlement of adjacent surfaces, structures, foundations, utilities and other properties. Any damage to the work under contract or to existing adjacent structures or other improvements caused by settlement, water or earth pressures, slides, cave-ins, or other causes due to lack of appropriate sheet piling, shoring, or bracing shall be repaired at the Contractor's expense at no delay.
- G. Trench sheet piling, shoring, and bracing shall be kept in place until pipe has been laid, tested for defects, and repaired if necessary, and the earth around the pipe is compacted. The sheet piling, shoring, and bracing shall be removed in such a manner as not to remove the constructed pipe or adjacent structures or other improvements.
- H. It shall be the Contractor's responsibility for proper and adequate placement of sheet piling, shoring, and bracing in accordance with all applicable regulations and standards.
- I. Whenever unsuitable or unstable soil for properly supporting the pipe or structures is encountered, a further depth and/or width shall be excavated and replaced with the foundation material specified herewith or other suitable foundation material and thoroughly compacted to assure a firm foundation for the pipe.
- J. Stockpile excavated material in an orderly manner, at sufficient distance from the trench to avoid overloading, to prevent slides and cave-ins.

- K. Contractor shall advise Engineer immediately if any unsuitable materials are encountered during excavation. Unsuitable materials shall be reasonably separated from suitable materials and shall be considered surplus material at no additional cost to the Owner.
- L. If Contractor encounters excess excavation materials which meet the requirements of common fill, Contractor may use those materials as fill in common execution and fill areas. Excess surplus materials shall be stockpiled.
- M. Excavate to and over-depth of a minimum of 6-inches below pipe in areas of bedrock or other extensive rock formations by jack hammer or other approved method. Trench width shall be 1.25 times the outside diameter of the pipe.
- N. Remove unsuitable materials in accordance to the depth recommended by the soils testing laboratory beneath structures to obtain desired soil bearing capacity. Contractor shall notify Engineer prior to any additional excavation that is needed. Additional excavation shall be subject to approval by the Engineer and subject to additional payment as noted above.
- O. Removal of materials beyond required subgrade elevations or dimensions without specific approval from soils testing laboratory and Engineer as well as backfilling, compaction, and other work at the over excavated area shall be at the Contractor's own expense.
- P. Excavating and backfilling shall not be conducted in water. All excavations shall be maintained in a well-drained condition at all times. Contractor shall provide and maintain temporary drainage facilities as required, and as approved by the Engineer, at no additional cost to the Owner.
- Q. Do not interfere with 45-degree bearing splay of foundations. Underpin adjacent structures, as necessary, to prevent damage by excavation Work.
- R. Hand trim for bell and spigot pipe joints. Remove loose matter.
- S. Remove lumped subsoil, boulders, and rocks up to 1/3-cubic-yard, measured by volume.
- T. In the event of shrinkage of excavated soils, resulting in shrinkage of backfill along trenches, Contractor shall provide, haul, place, and compact suitable soil type S1 or S2 from source at no cost to Owner.
- U. Stockpile excavated material in an orderly manner, at sufficient distance from the trench to avoid overloading, to prevent slides and cave-ins. Remove excess material not being used from site.

3.03 PIPE FOUNDATION

- A. Whenever unsuitable or unstable soil for properly supporting the pipe or structures is encountered, a further depth and/or width shall be excavated and replaced with the foundation material specified herewith or other suitable foundation material and thoroughly compacted to assure a firm foundation for the pipe.
- B. Installation of stabilization-separation geotextile will be required to foundation material and native subgrade materials if foundation material cannot provide a working surface or prevent soils migration.
- C. Additional density testing may be required in unstable areas where unsuitable materials are found. Engineer shall determine stability of trench bottom.

3.04 PIPE BEDDING

- A. Trench bottom shall be cut true and even so that the barrel of the pipe will have a bearing over the full length. Bell holes shall be excavated to ensure the pipe is resting for its entire length on the bottom of the trench and required bedding.

3.05 BACKFILLING

A. Pipe Zone

- 1. Should the materials available within the trench section be unsuitable or insufficient for this portion of the granular bedding, encasement and backfill materials as defined in this Specification, Contractor shall provide an approved material that meets the appropriate specifications.
- 2. Backfill materials shall be placed with care and deposited uniformly on both sides of pipe throughout the entire trench width in maximum 8-inch lifts. Mechanically compact material to required densities.
- 3. Flexible pipe shall be bedded in accordance with ASTM Specification D2321, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe." This shall include the placement of granular bedding and encasement materials from a point six-inches (6") below the bottom of the pipe to a point eighteen-inches (18") above the top of the pipe compacted to required densities.
- 4. Placement and compaction of bedding, encasement, and backfill materials shall be considered incidental to the installation of the pipe.

B. Trench Zone

- 1. Use suitable excavated materials from the site prior to importing of select granular borrow material. Any additional suitable granular backfill material required to be imported shall be provided by the Contractor at no additional

cost to the Owner. Contractor shall separate out all unsuitable materials. Excess surplus materials shall be removed from the Site.

2. Select granular borrow shall be used in areas under structures, roadbeds, and driveways.
3. Provide replacement backfill as required to establish required subgrade elevation. Use select granular borrow for replacement backfill.
4. Place backfill materials in uniform layers no more the 8-inches loose depth. Mechanically compact each layer of material to required densities.
5. Do not backfill unless approved compaction equipment is operating. The method of means of placement and type of compaction equipment used is at the discretion of the Contractor, however, all portions of the trench backfill must meet the compaction requirements. Tests to determine the compacted density of the backfill may be ordered by the Engineer if the compaction does not appear to be adequate.
6. The intent of this specification is to compact the backfill enough to prevent large settlements above the pipe, but to use as little effort as possible to avoid disturbing the pipe and bedding at the pipe zone.

- C. Backfill trenches to contours and elevations with unfrozen fill materials.
- D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- E. Aggregate Fill: Place and compact materials in equal continuous layers not exceeding 8-inches loose depth.
- F. Soil Fill: Place and compact material in equal continuous layers not exceeding 8-inches loose depth.
- G. Employ a placement method that does not disturb or damage utilities in trench. Prevent floatation of pipe.
- H. Maintain optimum moisture content of fill materials to attain required compaction density. Use vibratory or special compaction equipment when required.
- I. Remove surplus fill materials from site.
- J. Leave fill material stockpile areas completely free of excess fill materials. Contractor shall have the responsibility to load, haul, and spread all excess fill off-site.

3.06 COMPACTION REQUIREMENTS

- A. Compact according to Section 01 45 00 – Quality Control.
- B. Contractor shall re-compact all areas represented by failed density tests.
- C. Contractor shall protect flexible pipe during compaction.

3.07 TOLERANCES

- A. Top Surface of Backfilling:
 - 1. +/- 1 inch upon completion of settlement in ditches, berms, and lawn areas.
 - 2. +/- 1 inch upon completion of settlement in roadways and driveways.
- B. Trenches shall be kept within settlement tolerances through the warranty period.

3.08 FIELD QUALITY CONTROL

- A. Section 01 45 00 – Quality Control.
- B. Compaction testing will be performed in accordance with ASTM D698, and ASTM D2922.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no additional cost to Owner.

3.09 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 50 00 – Temporary Facilities and Controls.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

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SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SUMMARY

- A. Prevention of sedimentation of waterways, wetlands, and storm and sanitary sewers due to construction activities.
- B. Restoration of areas eroded due to insufficient preventative measures.
- C. Related Sections include, but are not limited to:
 - 1. Division 31 – Earthwork
 - 2. Division 32 – Exterior Improvements
 - 3. Division 33 – Utilities

1.02 REFERENCES

- A. ASTM D 4355 – Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc Type Apparatus; 2014 (Reapproved 2018).
- B. ASTM D 4491 – Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2020e1.
- C. ASTM D 4533 – Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015.
- D. ASTM D 4632 – Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a.
- E. ASTM D 4751 – Standard Test Method for Determining Apparent Opening Size of a Geotextile; 2020a.
- F. ASTM D 4873 – Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples, 2017.

1.03 SUBMITTALS

- A. Submit the following in accordance with Section 01 33 00
 - 1. Erosion Control Materials

PART 2 PRODUCTS

2.01 SILT FENCE

- A. Geotextile Fabric shall have a minimum water flow rate of 8 gpm/sf (ASTM D-4491), a minimum 80% UV resistance (ASTM D-4355), and a minimum Mullen burst rating of 300 psi (ASTM D-3786).
- B. Wire mesh reinforcement shall be free from rust and in good general condition at the time of installation.
- C. Wooden fence post shall be a minimum 5.0-feet in height; hard wood that is sturdy; and free from cracking. Metal fence post shall be free from excessive deformation.

2.02 FIBER ROLLS

- A. Fiber material shall be weed free wheat straw, rice straw or coconut fiber wrapped in tubular plastic netting.
- B. Fiber rolls shall be a minimum of nine inches in diameter (+/- one inch), with a minimum length of 10 feet, and approximate weight of 1 25 pounds per foot.
- C. Wood stakes (2" X 2" X 24") or metal pins.

2.03 EROSION CONTROL BLANKET

- A. The rolled erosion control product (RECP) blanket shall be a machine-produced 100% biodegradable blanket of 70% agricultural straw and 30% coconut fiber blend matrix with a functional longevity of up to 24 months.
- B. The blanket shall be of consistent thickness with the straw and coconut fiber evenly distributed over the entire area of the blanket. The blanket shall be covered on the top and bottom sides with 100% biodegradable woven polypropylene netting having ultraviolet additives to delay breakdown and an approximate 0.63-inch x 0.6 3- inch mesh, and on the bottom side with a lightweight photo-degradable polypropylene netting with an approximate 0.50 inch x 0.50-inch mesh. The blanket shall be sewn together on 1.50-inch centers with degradable thread.
- C. The RECP shall be manufactured with installation staple patterns clearly marked on the erosion control blanket with environmentally safe paint. The blanket shall be manufactured with a colored line or thread stitched along both outer edges (approximately 2-5 inches from the edge) to ensure proper material overlapping.
- D. The RECP straw/coconut fiber erosion control blanket shall have the following properties (physical specifications (per roll)):

- 1. Thickness: 0.34-inch ASTM D5199/ECTC

2. Resiliency: 75% ECTC Guidelines
3. Mass Per Unit Area: 11.44 oz/sy ASTM D6475
4. Water Adsorption: 200% ASTM D1117/ECTC
5. Swell: 30% ECTC Guidelines
6. Stiffness/Flexibility: 1.11 oz-in ASTM D1388/ECTC
7. Light Penetration: 11.70% ECTC Guidelines
8. Smolder Resistance: Yes ECTC Guidelines
9. MD Tensile Strength: 205.20 lbs/ft ASTM D5035
10. MD Elongation: 28.00% ASTM D5035
11. TD Tensile Strength: 152.40 lbs/ft ASTM D5035
12. TD Elongation: 23.10% ASTM D5035
13. The erosion control blanket shall be fumigated to kill noxious weed seeds, insects, fungi, and other invasive species.
14. MD – Machine direction
15. TD – Transverse direction

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

3.02 PREPARATION

- A. The Contractor shall develop a Storm Water Pollution Prevention Plan as required by the Utah Department of Environmental Quality that meets both the State's requirements and the minimum practices shown on the Drawings.
- B. The Contractor shall complete and sign the Notice of Intent and submit to the Utah Department of Environmental Quality.

3.03 EROSION CONTROL BLANKET

- A. Prepare soil before installing erosion control blankets, including any necessary application of lime, fertilizer, seed and roughening.
- B. Begin at the top of the slope by anchoring the erosion control blanket in a 6" deep X 6" wide trench with approximately 12" of the erosion control blanket extended beyond the up-slope portion of the trench. Backfill and compact the trench after stapling. Apply seed to compacted soil and fold remaining 12" portion of blanket back over seed and compacted soil. Secure erosion control blanket over compacted soil with a row of staples/stakes spaced approximately 12" apart across the width of the erosion control blanket

- C. Roll the erosion control blanket down or horizontally across the slope. Erosion control blankets will unroll with appropriate side against the soil surface. All erosion control blankets must be securely fastened to soil surface by placing staples/stakes in appropriate locations as shown in the staple pattern guide. Staples/stakes should be placed through each of the colored dots corresponding to the appropriate staple pattern.
- D. The edges of parallel erosion control blankets must be stapled with approximately 2" to 5" overlap depending on erosion control blanket type. To ensure proper seam alignment, place the edge of the overlapping erosion control blanket (blanket being installed on top) even with the colored seam stitch™ on the previously installed blanket.
- E. Consecutive erosion control blankets spliced down the slope must be placed end over end (shingle style) with an approximate 3" overlap. Staple through overlapped area, approximately 12" apart across entire blanket width.

3.04 FIBER ROLLS

- A. They shall be placed on contour and staked with 24-inch wood stakes or metal pins, at a maximum spacing of four foot on center. The ends of adjacent Straw Wattles shall be abutted to each other snugly.
- B. Fiber rolls remain on site requiring maintenance by the contractor throughout the project. Sediment buildup shall be removed when it reaches 1/3 the height of the fiber roll. Any ineffective (decomposed, torn, collapsed materials) fiber rolls must be replaced immediately. Upon final stabilization it will be the responsibility of the contractor to remove materials as directed by the engineer. Disposal shall be the contractor's responsibility.

3.05 SILT FENCE

- A. Excavate a 6-inches deep by 4-inches wide trench. Drive posts into ground on downstream side of fence (posts may be alternated on grades less than 2% to provide additional protection against wind damage). Posts shall have a maximum spacing of 8-feet on center.
- B. Fasten wire mesh to posts. Unroll geotextile fabric one section at a time. Lay fabric flap in trench. Backfill with soil and tamp the ground. Attach fabric to support posts.
- C. Silt fence remains on site requiring maintenance by the contractor throughout the project. Sediment buildup shall be removed when it reaches 1/3 the height of the silt fence. Any ineffective (decomposed, torn, collapsed materials) silt fences must be replaced immediately. Upon final stabilization it will be the responsibility of the contractor to remove materials as directed by the engineer. Disposal shall be the contractor's responsibility.

3.06 PERFORMANCE REQUIREMENTS

- A. Contractor shall comply with all requirements of the Utah Department of Environmental Quality along with all Federal, State, and Local permits and regulations for erosion and sediment control.
 - 1. If erosion or sedimentation occurs due to non-compliance with any of these permits, Contractor shall restore eroded areas at no cost to Owner.
 - 2. If sedimentation beyond permitted thresholds occurs in regulated waterways or wetlands, Contractor shall at no additional cost to the Owner:
 - a. Contact the authorities having jurisdiction.
 - b. Remove deposited sediments to the satisfaction of the Owner and the authorities having jurisdiction.
 - c. Install or correct preventive measures to the satisfaction of the authorities having jurisdiction; and
 - d. Pay any fines or other additional requirements of the authorities having jurisdiction; and
 - e. Meet the Contract schedule for project completion.
- B. Contractor shall not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. Obtain and pay for permits and provide security required by authority having jurisdiction.
- C. Timing of erosion and sediment control practices:
- D. Erosion Control: Contractor shall reduce wind, water, and vehicular erosion of soil on project site due to construction activities for this project, consistent with approved permits and following these requirements:
 - 1. Minimum erosion control measures as shown on the Drawings with additional practices implemented as required by the Contractor's SWPPP.
 - 2. Control movement of sediment and soil from temporary stockpiles of soil.
 - 3. Prevent development of ruts due to equipment and vehicular traffic.
 - 4. Provide good site housekeeping.
 - 5. Inspect, repair, maintain, and replace erosion control practices consistent with approved permits and as shown on the Drawings.
- E. Sediment Control: Contractor shall reduce sediment transport off- site due to construction activities for this project, consistent with approved permits and following these requirements:
 - 1. Minimum sediment control measures as shown on the Drawings with additional practices implemented as required by the Contractor's SWPPP.
 - 2. Reduce windblown soil from leaving the project site.

3. Reduce tracking of mud onto public roads outside of the site.
4. Reduce mud and sediment from flowing onto sidewalks and pavements.
5. Inspect, repair, maintain, and replace sediment control practices consistent with approved permits and as shown on the Drawings.

3.07 CLOSE-OUT

- A. Contractor shall file a Notice of Termination with the State following site stabilization that meets the requirements of the General Permit.
- B. Contractor shall remove and clean up all temporary erosion and sediment control practices as shown on the Drawings. Site disturbance caused by removal of these practices shall be restored consistent with the surface restoration requirements shown on the Drawings. Costs for restoration shall be at Contractor's expense.

END OF SECTION

SECTION 31 41 00
SHORING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Work related to sheeting, shoring, bracing, and excavation support systems needed to accomplish construction of buildings, tanks, facilities, utilities, and piping.

B. Related sections include, but are not limited to:

1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
2. Section 03 30 00 – Cast-in-Place Concrete
3. Division 1 – General Requirement Specification Sections
4. Division 31 – Earthwork Specification Sections.

1.02 SUBMITTALS

A. Shop Drawings and Product Data: Submit, in accordance with Section 01 33 00. In general, include drawings and supporting calculations for shoring for Engineer review and approval.

B. Submittals shall include:

1. Excavation support plan.
2. Movement monitoring plan.
3. Trench excavation plan.
4. Movement measurement and data and reduced results indicating movement trends.
5. Documentation that shoring plan or system has been designed by a registered Professional Engineer if required.

C. Design calculations of bracing and shoring showing member stresses and connections due to imposed loads. Calculations shall be sealed by a qualified professional engineer.

1.03 QUALITY ASSURANCE

A. Excavations shall comply with the requirements of OSHA 29 CFR, Part 2926, Subpart P, "Excavations and Trenches." Excavation safety is the responsibility of the Contractor. All excavations greater than 20-feet in depth shall be designed by a registered Professional Engineer.

- B. Sheeting, shoring, and bracing shall conform to safety requirements of federal, state, and local agencies.
- C. Sheeting, shoring, and bracing shall not affect structural integrity of existing structures, utilities, or Work, and shall allow for sufficient clearances necessary to install associated appurtenances adjacent to new Work.
- D. Sheeting, shoring, and bracing shall not penetrate walls or slabs of new Work unless approved by the Engineer.
- E. Provide surveys to monitor movements of critical facilities.

1.04 REGULATORY REQUIREMENTS

- A. Work outlined in this Section shall conform to OSHA regulations and all applicable codes and regulations for worker safety.

PART 2 PRODUCTS

2.01 SHEETING, SHORING, AND BRACING

- A. Type, design, detail, and installation of sheeting, shoring, and bracing shall be determined by and be the sole responsibility of the contractor.

PART 3 EXECUTION

3.01 GENERAL

- A. Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work. Shoring, sheeting, and bracing shall also be provided as necessary to protect workers and the public.
- B. Sheeting, shoring, and bracing shall be installed to prevent solids from entering excavation below or through sheeting.
- C. Open cut excavations are to be evaluated by a registered Engineer and protected against surface water intrusion.

3.02 EXCAVATION SUPPORT PLAN

- A. Prepare an excavation support plan addressing the following topics:
 - 1. Select and install shoring system such that no adverse impact occurs on existing structures, utilities, or facilities.
 - 2. Details of shoring, bracing, sloping, or other provisions for worker protection from hazards of caving ground.

3. Design assumptions and calculations.
4. Methods and sequencing of installing excavation support.
5. Proposed locations of stockpiled excavated material.
6. Minimum lateral distance from the crest of slopes for vehicles and stockpiled excavated materials.
7. Anticipated difficulties and proposed resolutions.

3.03 MOVEMENT MONITORING PLAN

- A. Prepare movement monitoring plan addressing following topics:
 1. Survey control.
 2. Location of monitoring points.
 3. Plots of data trends.
 4. Interval between surveys.
 - a. Interval shall not be less than once per week during performance of work until the permanent structure is complete to the ground level and shall continue weekly for a period of four (4) weeks after completion of the work (or longer if movement persists).
 5. Remedial action and engineer notification plan should movement of existing structures occur during performance of the Work.

3.04 REMOVAL OF EXCAVATION SUPPORT

- A. Remove excavation support in a manner that will maintain support as excavation is backfilled.
- B. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.
- C. Remove excavation support in a manner that does not leave voids in the backfill.

3.05 TRENCHES

- A. Provide trench excavations exceeding four (4) feet in depth with adequate safety systems.
- B. For trench excavation exceeding five (5) feet in depth, provide adequate safety systems meeting requirements of applicable state and local construction safety orders, and federal requirements.

END OF SECTION

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DIVISION 32 EXTERIOR IMPROVEMENTS

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SECTION 32 05 16
AGGREGATES FOR EXTERIOR IMPROVEMENTS

PART 1 **GENERAL**

1.01 SUMMARY

A. Section includes:

1. Aggregate materials.

B. Related Sections include, but are not limited to:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 01 – General Requirements.
3. Division 31 – Earthwork.
4. Division 32 – Exterior Improvements.
5. Section 31 23 23 – Fill and Backfill.
6. Section 31 23 33 – Trenching and Backfilling.

1.02 REFERENCES

A. Utah Department of Transportation Standard Specifications for Road and Bridge Construction - Latest Edition.

1.03 SUBMITTALS FOR REVIEW

A. Section 01 33 00 – Submittal Procedures.

B. Samples: Submit, in air-tight containers, 40-pound sample of each type of aggregate to testing laboratory. Submit Laboratory Results to Engineer.

1.04 QUALITY ASSURANCE

A. Section 01 45 00 – Quality Control.

B. Material Source: Submit name of imported material supplier(s). Provide materials from the same source throughout the Work. Change of source requires Engineer approval.

PART 2 **PRODUCTS**

2.01 AGGREGATE MATERIALS

A. Coarse Aggregate (Type A1): Well graded crushed stone or gravel conforming to the requirements of ASTM C33, Gradation 67.

- B. Coarse Aggregate (3/4-inch Minus Aggregate Surface Course and Type A2): Gravel; angular crushed, or natural stone; free of shale, clay, friable material and debris; with gradation within the following limits:

<u>Sieve Size</u>	<u>Percent Passing (%)</u>
3/4-in.	100
No. 4	40 to 70
No. 10	25 to 55
No. 200	2 to 8

- C. Fine Aggregate (Granular Bedding, Granular Encasement and Type A5):

1. Imported Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic material shall be sand and silty sands conforming to ASTM D2487 Group Symbol SP or SP-SM and graded in accordance with the following table, when tested in accordance with ASTM C117 and C136. When metallic pipe, valves, or fittings are used, the material shall also be free of sharp angular particles which may damage coatings or other corrosion protection materials.

<u>Sieve Size</u>	<u>Percent Passing (%)</u>
3/4-in.	95 to 100
3/8-in.	75 to 100
No. 4	35 to 95
No. 200	0 to 9

2. Imported Bedding Material shall be used to bed all pipe, fittings, hydrants, couplings, or valves.
3. The Imported Bedding Material aggregate shall be free from all organic matter, lumps or balls of clay, frozen material. The PI of bedding shall be non-plastic (NP) or the fines shall be classified as silt (ML) based on the PI.
4. Where metallic pipe, valves, or fittings are used, the material shall have an electrical resistivity greater than 900 ohm-cm in accordance with ASTM G57 (to ensure pipe is surrounded in material that is not corrosive).

No clays shall be mixed with the material in the pipe-zone (to ensure water cannot be trapped in the pipe-zone). This requirement includes metal valves and fittings.

- D. Base Coarse: Base course material should be comprised of Untreated Base Course Aggregate Class "B" per Section 02721 of the Utah Department of Transportation Standard Specifications.
- E. Structural Fill: Fine sand and gravel, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Conforming to ASTM D2487 Group Symbol GM, GC, SM, SC, SP, SW, or dual symbol groups with gradation within the following limits.

Gradation Requirements

<u>Standard Sieve Size</u>	<u>Percent Passing (%)</u>
4 inch	100
3/4 inch	70 to 100
No. 4	50 max
No. 200	20 max*

Plasticity Requirements of Fines (Atterberg Limits)

Plasticity Index	6 or less
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*Fill with more than 20 percent fines may be acceptable as approved by the Geotechnical Engineer.

- F. Granular Foundation Rock: Mixture of crushed and uncrushed rock, with at least 35% of the rock fraction having 1 or more natural or manufactured fractured faces, meeting ASTM C33 1" nominal size aggregate sizes #4 through #57.

2.02 SOURCE QUALITY CONTROL

- A. Section 01 45 00 – Quality Control.
- B. Coarse Aggregate Material – Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698.
- C. Fine Aggregate Material – Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D698.
- D. If tests indicate materials do not meet specified requirements, change material or material source and retest.
- E. Provide materials of each type of aggregate from the same source throughout the Work.

PART 3 EXECUTION

3.01 STOCKPILING

- A. Stockpile materials in accordance with Section 31 14 13 – Soil Stripping and Stockpiling.

3.02 STOCKPILE CLEANUP

- A. Cleanup stockpiles in accordance with Section 31 14 13 – Soil Stripping and Stockpiling.

END OF SECTION

SECTION 32 05 19
GEOSYNTHETICS FOR EXTERIOR IMPROVEMENTS

PART 1 **GENERAL**

1.01 SUMMARY

- A. Section includes:
 - 1. Non-Woven Geotextile Fabric.
 - 2. Woven Geotextile Reinforcement Fabric.
- B. Related Sections include, but are not limited to:
 - 1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
 - 2. Division 1 – General Requirements Specification Sections.
 - 3. Division 31 – Earthwork Specification Sections.
 - 4. Division 32 – Exterior Improvements.

1.02 REFERENCES

- A. Reference Standards include, but are not limited to:
 - 1. Utah Department of Transportation Standard Specifications for Road and Bridge Construction - Latest Edition.
 - 2. ASTM D3786 – Mullen Burst, Latest Edition.
 - 3. ASTM D4355 – UV-Resistance, Latest Edition.
 - 4. ASTM D4491 – Water Permeability, of Geotextiles by Permittivity, Latest Edition.
 - 5. ASTM D4595 – Wide Width Tensile Strength, Latest Edition.
 - 6. ASTM D4632 – Grab Tensile Strength and Elongation, Latest Edition.
 - 7. ASTM D4751 – Apparent Opening Size (AOS), Latest Edition.
 - 8. ASTM D4833 – Puncture and Trapezoidal Tear, Latest Edition.
 - 9. ASTM D4873 – Guide for Identification, Storage, and Handling of Geosynthetics, Latest Edition.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Provide product data on Geotextile Fabric.
- C. Submit manufacturer's installation instructions. Indicate special procedures and conditions requiring special attention.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. The geotextile rolls shall be furnished with suitable wrapping for protection against moisture and extended ultraviolet exposure prior to placement.
- B. Rolls shall be stored in a manner which protects them from the elements. At no time shall the geotextile be exposed to ultraviolet light for a period exceeding fourteen days.
- C. The geotextile rolls shall be labeled as per ASTM D 4873, "Guide for Identification, Storage, and Handling of Geosynthetics".

PART 2 PRODUCTS

2.01 MATERIAL

- A. Non-Woven Geotextile Fabric: Soil separation and drainage applications, rip rap support, rolls 12.5'/15' wide x 300' long and with the following properties:
 - 1. Grab Tensile Strength ASTM D4632 180 lbs.
 - 2. Grab Tensile Elongation ASTM D4632 50%.
 - 3. Mullen Burst ASTM D3786 225 psi.
 - 4. Puncture ASTM D4833 65 lbs.
 - 5. Trapezoid Tear ASTM D4533 50 lbs.
 - 6. UV-Resistance ASTM D4355 70%
 - 7. Apparent Opening Size ASTM D4751 70 US Sieve.
 - 8. Permittivity ASTM D4491 1.8 Sec-1.
 - 9. Flow Rate ASTM D4491 135 gpm/ft².
- B. Woven Geotextile Fabric: Soil stabilization & reinforcement, rolls 12.5'/15' wide x 300' long and with the following properties:
 - 1. Wide Width Tensile
 - 2. Strength at 5 percent strain: ASTM D 4595 1560 lbs/ft
 - 3. Puncture: ASTM D 4833 95 lbs.
 - 4. Mullen Burst: ASTM D 3786 460 psi.
 - 5. Trapezoid Tear: ASTM D 4533 75 lbs.
 - 6. Apparent Opening Size: ASTM D 4751 40 US Sieve.
 - 7. Permeability: ASTM D 4491 0.025 Sec-1.
 - 8. Water Flow Rate: ASTM D 4491 2 gpm/ft².
 - 9. UV-Resistance: ASTM D 4355 70 %

2.02 MANUFACTURERS

- A. Acceptable Manufacturers for Non-woven Fabric:
 - 1. Mirafi, Series 140N.

2. Approved Equal.
- B. Acceptable Manufacturers for Woven Fabric:
1. Mirafi, Geolon HP-565.
 2. Approved Equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify subgrade has been inspected, gradients and elevations are correct, surface is dry, and ready to receive Work.

3.02 PREPARATION OF SUBSOIL

- A. Correct irregularities in subgrade gradient and elevation by scarifying a minimum of 6-inches, reshaping, and re-compacting.
- B. Do not place on soft, muddy, or frozen surfaces.

3.03 PLACEMENT

- A. Install in accordance with manufacturer's instructions.
- B. The geotextile shall be laid out smooth without wrinkles or folds on the prepared subgrade in the direction of the construction traffic.
- C. Adjacent geotextile rolls shall be overlapped a minimum of 2.5 feet; ends of rolls shall be overlapped 3 feet.
- D. On curves, the fabric may be folded or cut to conform to the curves. The fold or overlap shall be in the direction of construction and shall be held in place by staples, pins or aggregate piles.
- E. Damaged areas shall be repaired by overlaying the area with sufficient material to overlap on all edges by at least 2.5 feet.
- F. The aggregate base material shall be placed by end dumping onto the geotextile from the edge or over previously placed base aggregate. Construction equipment will not be allowed directly on the geotextile fabric.
- G. A minimum of 6 inches of aggregate must be placed on the geotextile prior to the movement of construction equipment above the fabric.
- H. Turning movements must be carefully monitored to avoid rutting of the aggregate. Any ruts occurring during construction shall be filled with additional gravel aggregate and compacted to the specified density.

I. If placement of the backfill causes damage to the geotextile, the damaged area shall be repaired as described in Section 3.03.E.

J. Install in the location as indicated on drawings.

3.04 FIELD QUALITY CONTROL

A. Section 01 45 00 – Quality Control: Field inspection.

END OF SECTION

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 **GENERAL**

1.01 SUMMARY

- A. Section includes general requirements and procedures for furnishing and installing base and pavement courses, including:
 - 1. Subbase Course.
 - 2. Aggregate Base Course.
- B. Related Sections include, but are not limited to:
 - 1. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.
 - 2. Division 1 – General Requirement Specification Sections.
 - 3. Division 31 – Earthwork Specification Sections.
 - 4. Division 32 – Exterior Improvements.

1.02 REFERENCES

- A. A. Reference Standards include, but are not limited to:
 - 1. ASTM D698 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb Rammer and 12-inch Drop.
 - 2. ASTM D2167 – Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
 - 3. ASTM D2922 – Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 4. ASTM D3017 – Test Methods for Moisture Content of Soil and Soil-Aggregate in place by Nuclear Methods (Shallow Depth).
 - 5. Utah Department of Transportation Standard Specifications for Road and Bridge Construction - Latest Edition.
 - 6. American Public Works Association (APWA) Utah Chapter Manual of Standard Specifications - Latest Edition

1.03 SUBMITTALS

- A. Section 01 30 00 – Submittals: Procedures for Submittals.
 - 1. Subbase Course
 - a. Provide appropriate material date source testing for each granular material. Include name location of source, date of testing, and sample gradations. Tests shall not be more than 180 calendar days before date of submittal.

2. Aggregate Base Course
 - a. Submit gradation report on sample of aggregate base to be used.

1.04 SEQUENCING AND SCHEDULING

- A. Construct aggregate base only after all of the following have been completed:
 1. Subgrade has been corrected for instability problems and successfully passed a rolling test performed by the Contractor and witnessed by the Engineer.
 2. Subgrade has been checked for conformance to line and string tolerances (stringline).
- B. Aggregate base to be completed and approved by Engineer prior to placement of bituminous surfaces.

1.05 QUALITY ASSURANCE

- A. Contractor shall establish and maintain the required lines and grades, including crown and cross-slope, for each course during work.
- B. In-place finished thickness will not be acceptable if exceeding following allowable variation from thickness specified herein:
 1. Aggregate Base Course: Plus or minus one-half inch.

PART 2 PRODUCTS

2.01 SUBBASE COURSE

- A. Subbase shall be Type S1 material as specified in Section 31 05 13 unless otherwise indicated as granular materials which are specified in Section 32 05 16.

2.02 AGGREGATE BASE COURSE

- A. Aggregate Base Course shall be as indicated on the Construction Drawings and as specified in Section 32 05 16.

PART 3 EXECUTION

3.01 AGGREGATE BASE COURSE

- A. Preparation:
 1. Verify subsoil has been inspected; gradients and elevations are correct.
 2. Prepare the sub-base course.

3. Verify subsoil is compacted to specified density and that subgrade test results have been submitted prior to placing aggregate course.
4. Subgrade to be completed and approved by Engineer prior to installation of the aggregate base course.
5. Verify subgrade is dry.

B. Construction Requirements:

1. Place aggregate in maximum 6-inch layers and compact to specified density. When placing over geotextile fabric, place in minimum 8-inch layers.
2. Level and contour surfaces to elevations and gradients indicated.
3. Compact by mechanical means as specified in Section 01 45 00.
4. Install aggregate base in accordance with Detail Drawings.
5. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
6. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

C. Field Quality Control:

1. The Owner shall have an independent testing laboratory sample the aggregate base materials, determine the moisture/density relationships and gradation, and perform field moisture/density tests at locations determined by Engineer.
2. If, during progress of Work, tests indicate that compacted materials do not meet specified requirements, remove defective Work, replace, and retest. Contractor shall bear all costs associated with repair and retesting of defective Work.

3.02 TOLERANCES

A. Finished Grade:

1. Line and Grade Tolerance: The final aggregate base surface will be checked for conformance to specified tolerances by the "stringline" method prior to approval to pave the surface. Grade shall be ± 0.03 feet of grade.

END OF SECTION

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SECTION 32 12 16
ASPHALT PAVING

PART 1 **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Bituminous Concrete Pavement.

B. Related Work:

1. The General Conditions, Supplementary Conditions, and General Requirements apply to work of this section.
2. Division 1 – General Requirements Specification Sections.
3. Division 31 – Earthwork Specification Sections.

1.02 REFERENCES

A. Reference Standards include:

1. Utah Department of Transportation Standard Specifications for Road and Bridge Construction - Latest Edition.
2. American Public Works Association (APWA) Utah Chapter Manual of Standard Specifications - Latest Edition
3. City of South Jordan, Chapter 2 - Amendment to APWA Standard Plans and Specifications

1.03 SUBMITTALS FOR REVIEW

A. Section 01 33 00 – Submittals: Procedures for submittals.

B. Product Data: Furnish data on aggregates, asphalt cement, bituminous mixtures, and other materials required for the mix in accordance with Section 01 33 00 and 01 45 00 at least 7 days prior to beginning paving operations.

C. Asphalt Mix Formula.

1.04 REFER TO APWA SPECIFICATION SECTION 32 12 05 - BITUMINOUS CONCRETE, PART 1 FOR FURTHER REQUIREMENTS.

PART 2 **PRODUCTS**

2.01 GENERAL

- A. Asphalt Cement: Asphalt Cement shall be produced in accordance with Utah APWA Specification Section 32 12 05 - Bituminous Concrete Pavement, and meeting the following requirements:
1. PG64-22, DM-1/2, 50 blow: PG64-22 is a Performance Graded Asphalt Binder. DM-1/2 is the aggregate grade. 50 blow is the compaction level at Marshall mix design.

PART 3 **EXECUTION**

- 3.01 REFER TO APWA SPECIFICATION SECTION 32 12 05 - BITUMINOUS CONCRETE, PART 3 FOR FURTHER REQUIREMENTS.

END OF SECTION

SECTION 32 13 14
CONCRETE SIDEWALKS, DRIVEWAYS, APPROACHES, CURB TURN FILLETS, VALLEY
GUTTERS, AND CURB & GUTTER CONCRETE CONSTRUCTION

PART 1 **GENERAL**

1.01 DESCRIPTION

- A. This work is the construction of concrete sidewalk and driveway approaches, curb turn fillets, valley gutters, new street monuments, curb and gutter, and all other miscellaneous new concrete construction complete in place.

1.02 REFERENCES

- A. AASHTO M 213 - Standard Specification for Preformed Expansion Joint Fillers for Concrete paving and structural construction
- B. AASHTO M 148 - Standard Specification for Liquid-Forming Compounds for Curing Concrete
- C. Utah Department of Transportation Standard Specifications for Road and Bridge Construction - Latest Edition.
- D. American Public Works Association (APWA) Utah Chapter Manual of Standard Specifications - Latest Edition

- 1.03 REFER TO APWA SPECIFICATION SECTION 32 16 13 - CONCRETE DRIVEWAY, SIDEWALK, CURB, GUTTER FOR FURTHER REQUIREMENTS ON PART 1, PART 2 AND PART 3 OF THIS SPECIFICATION.

PART 2 **PRODUCTS**

2.01 NOT USED

PART 3 **EXECUTION**

3.01 NOT USED

END OF SECTION

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DIVISION 33 UTILITIES

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SECTION 33 05 61
CONCRETE VAULTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete manholes.
- B. PRecast Concrete Vaults
- C. Shoe box lids

1.02 RELATED REQUIREMENTS

- A. Section 04 05 11 - Mortar and Masonry Grout.
- B. Section 31 23 16 - Excavation.
- C. Section 31 23 23 - Fill.

1.03 REFERENCE STANDARDS

- A. AASHTO HB - Standard Specifications for Highway Bridges; 2005, with Errata.
- B. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2020.
- C. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants; 2009 (Reapproved 2019).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide shoe box lid, component construction, features, configuration, and dimensions.

- C. Shop Drawings: Indicate vault locations, elevations, piping sizes and elevations of penetrations.
- D. Manufacturer's qualification statement.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Project Record Documents:

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 CONCRETE VAULT

- A. Weight Rating: Pedestrian according to AASHTO HB.
- B. Vault foundation must be designed for loading of vault full of water to the 12" overflow.
- C. Precast Concrete Vault: Comply with ASTM C478/C478M, reinforced.
 - 1. Wall Thickness: 8 inches.
 - 2. Base Thickness: 12 inches.
 - 3. Lid Thickness: 10 inches.
 - 4. Reinforcement: Rebar as needed.
 - 5. Joint Sealant: Comply with NSF/ ANSI 61.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of work are properly sized and located.
- B. Verify that built-in items are in proper location, and ready for roughing into Work.
- C. Verify excavation for manholes is correct.

3.02 PREPARATION

- A. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections.

3.03 EXCAVATION AND FILL

- A. Hand trim excavation for accurate placement to indicated elevations.
- B. Backfill with cover fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION

- A. Establish elevations and pipe inverts for inlets and outlets as indicated in drawings.
- B. Precast Concrete Manholes:
 - 1. Place base section plumb and level.
 - 2. Install joint sealant uniformly around section lip.
 - 3. Overlay additional sections on joint sealant.
 - 4. Install Gator wrap around exterior of seams.
 - 5. Install lid plumb and level on joint sealant.

END OF SECTION

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SECTION 33 05 26
UTILITY IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. GPS Mapping
 - 2. Tracer Wire for Non-Metallic Pipe.
 - 3. Tracer Wire Access Box.
 - 4. Detector tape.
- B. Related Sections include, but are not limited to:
 - 1. Section 01 33 00 – Submittal Procedures.
 - 2. Section 33 05 05 – Trenching and Backfilling.
 - 3. Section 33 11 00 – Water Utility Distribution Piping.
 - 4. Section 33 11 13 – Steel Water Transmission Piping.

1.02 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Submit manufacturer's data on materials furnished indicating compliance with the specifications.

PART 2 PRODUCTS

2.01 TRACER WIRE MATERIALS

- A. Approved Manufacturers:
 - 1. Copper Clad Steel (CCS) Trace Wire
 - a. Open Trench
 - 1) Copperhead #12 High Strength part # 1230-HS
 - 2) Approved Equivalent
 - b. Directional Drilling/Bore
 - 1) Copperhead Extra High Strength part # 1245*EHS
 - 2) Approved Equivalent
 - 2. Connectors
 - a. Copperhead 3-way locking connector part # LSC1230*
 - b. DryConn 3-way Direct Bury Lug: Copperhead Part # 3WB-01
 - c. Approved Equivalent

3. Termination/Access
 - a. Non-Roadway access boxes applications:
 - 1) Trace wire access boxes Grade level Copperhead adjustable lite duty Part # LD14*TP
 - 2) Approved Equivalent
 - b. Concrete/Driveway access box applications:
 - 1) Trace wire access boxes Grade level Copperhead Part # CD14*TP 14"
 - 2) Approved Equivalent
 - c. Fire hydrant trace wire access box applications:
 - 1) Above ground two terminal with 1" conduit. Copperhead part # T3-75-F (Cobra T3 Test Station, denoting "F" includes mounting flange)
 - 2) Approved Equivalent
4. Grounding
 - a. Drive in Megnesium Anode: Copperhead Part # ANO-1005 (1.5 lb)
 - b. Approved Equivalent

B. Tracer Wire

1. Direct bury wire. Installed on all underground utilities such as water and sewer pipes.
2. Trace wire shall have HDPE insulation intended for direct bury, color coated per APWA standard for the specific utility being marked.
3. Open Trench Trace wire - Trace wire shall be #12 AWG Copper Clad Steel, High Strength with minimum 450 lb. break load, with minimum 30 mil HDPE insulation thickness.
4. Directional Drilling/Boring Trace wire - Trace wire shall be #10 AWG Copper Clad Steel, Extra High Strength with minimum 1,150 lb. break load, with minimum 30 mil HDPE insulation thickness.

C. Tees

1. All mainline trace wires shall be interconnected in intersections, at mainline tees and mainline crosses.
 - a. Tees: the three wires shall be joined using a single 3-way lockable connector.
 - b. Crosses: the four wires shall be joined using a 4-way connector. Use of two 3-way connectors with a short jumper wire between them is an acceptable alternative.
- 2.

3. Non-locking friction fit, twist on or taped connectors are prohibited.

D. Trace Wire Termination/Access

1. All trace wire termination points shall utilize an approved trace wire access box (above ground access box or grade level/in-ground access box as applicable), specifically manufactured for this purpose.
2. All grade level/in-ground access boxes shall be appropriately identified with “water” cast into the cap and be color coded.
3. A minimum of 2 ft. of excess/slack wire is required in all trace wire access boxes after meeting final elevation.
4. All trace wire access boxes must include a manually interruptible conductive/connective link between the terminal(s) for the trace wire connection and the terminal for the grounding anode wire connection.
5. Grounding anode wire shall be connected to the identified (or bottom) terminal on all access boxes.
6. Service Laterals on public property – Trace wire must terminate at an approved grade level/inground trace wire access box, located at the edge of the road right-of-way, and out of the roadway at all fire hydrants, curb stops, and service laterals.
7. Service Laterals on private property – Trace wire must terminate at an approved above-ground trace wire access box, affixed to the building exterior directly above where the utility enters the building, at an elevation not greater than 5 vertical feet above finished grade, or terminate at an approved grade level/in-ground trace wire access box, located within 2 linear feet of the building being served by the utility.
8. Hydrants – Trace wire must terminate at an approved above-ground trace wire access box, properly affixed to the hydrant grade flange. (affixing with tape or plastic ties shall not be acceptable)
9. Long-runs, in excess of 500 linear feet without service laterals or hydrants – Trace wire access must be provided utilizing an approved grade level/in-ground trace wire access box, located at the edge of the road right-of-way, and out of the roadway. The grade level/in-ground trace wire access box shall be delineated using a minimum 48” polyethylene marker post, color coded per APWA standard for the specific utility being marked.

E. Trace Wire Grounding

1. Trace wire must be properly grounded at all dead ends/stubs
2. Grounding of trace wire shall be achieved by use of a drive-in magnesium grounding anode rod with a minimum of 20ft of #14 red HDPE insulated copper clad steel wire connected to anode (minimum 0.5 lb.) specifically

manufactured for this purpose, and buried at the same elevation as the utility.

3. When grounding the trace wire at dead ends/stubs, the grounding anode shall be installed in a direction 180 degrees opposite of the trace wire, at the maximum possible distance.
4. When grounding the trace wire in areas where the trace wire is continuous and neither the mainline trace wire or the grounding anode wire will be terminated at/above grade, install grounding anode directly beneath and in-line with the trace wire. Do not coil excess wire from grounding anode. In this installation method, the grounding anode wire shall be trimmed to an appropriate length before connecting to trace wire with a mainline to lateral lug connector.
5. Where the anode wire will be connected to a trace wire access box, a minimum of 2 ft. of excess/slack wire is required after meeting final elevation.

F. Prohibited Products and Methods

1. Un-insulated trace wire
2. Trace wire insulations other than HDPE
3. Non locking, friction fit, twist on or taped connectors
4. Brass or copper ground rods
5. Wire connections utilizing taping or spray-on waterproofing
6. Looped wire or continuous wire installations, that has multiple wires laid side-by-side or in close proximity to one another
7. Trace wire wrapped around the corresponding utility
8. Brass fittings with trace wire connection lugs
9. Wire terminations within the roadway, i.e. in valve boxes, cleanouts, manholes, etc.
10. Connecting trace wire to existing conductive utilities

2.02 DETECTOR TAPE MATERIALS

A. MATERIALS

1. Detectable Solid Aluminum Foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
 - a. Manufacturers and Products:
 - 1) Mutual Industries; Detectable Tape.
 - 2) Reef Industries; Terra Tape, Sentry Line Detectable.
 - 3) Presco; Detectable Tape.
 - b. "Terra Tape" as manufactured by:
 - 1) REEF Industries, Inc., or

- c. Width: 6-inch.
- d. Color: In accordance with APWA Uniform Color Code.

PART 3 EXECUTION

3.01 GPS MAPPING

- A. All piping and fittings shall be mapped using GPS after final locations have been determined and prior to backfilling. GPS shall provide horizontal and vertical control.
- B. GPS points shall be recorded at minimum at the following locations:
 - 1. Along all piping lengths at a distance not to exceed 100 feet between points.
 - 2. All points where a pipe experiences a change in direction. If a pipe is installed in a bent fashion the number of GPS points taken shall be sufficient to accurately determine the location of the pipe through the bend.
 - 3. All fittings such as elbow, tees, etc. shall be mapped.
 - 4. Pipe terminals – beginnings and endings.
- C. Saving of GPS data shall be confirmed prior to backfilling. GPS mapping data shall be submitted to the Engineer in an organized manner.

3.02 DETECTOR TAPE INSTALLATION

- A. Install the detector tape 24-inches below finished grade directly above and parallel with pipelines. Detector tape shall be installed for all site piping outlined in Section 33 11 00 – Water Utility Distribution Piping, Section 33 11 13 – Steel Water Utility Transmission Piping, and the Piping Schedule and shall be labeled in accordance with this section.
- B. At each manhole, bring the detector tape up to the manhole to a point approximately 24-inches below finished grade. Drill through the manhole and pull the detector tape through the manhole and label the loose end with a plastic marker. Grout hole with non-shrink grout or water stop material.

3.03 TRACER WIRE INSTALLATION

- A. At each buried appurtenance, bring the tracer wire up to ground level to a point of easy connection for testing and appropriately mounted.
- B. Tracer wire, access boxes, and accessories shall be incidental to the pipe installation cost.

END OF SECTION

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SECTION 33 11 00
WATER UTILITY DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Piping Materials and Fittings
2. Polyethylene Encasement
3. Valves
4. Reaction Backing (Thrust Blocking)
5. Bedding and Backfilling
6. Fire Hydrants
7. Appurtenances
8. Pipe Installation
9. Pipe Thrust Restraint
10. Dismantling Joints.

B. Related Sections include, but are not limited to:

1. Section 01 31 00 – Coordination and Meetings.
2. Section 01 33 00 – Submittal Procedures.
3. Section 01 45 00 – Quality Control.
4. Section 01 61 00 – Common Product Requirements.
5. Section 31 05 13 – Soils for Earthwork.
6. Section 31 23 33 – Trenching and Backfilling.
7. Section 32 05 16 – Aggregates for Exterior Improvements.
8. Section 33 11 13 – Steel Water Transmission Pipe
9. Section 33 11 14 – Ductile Iron Pipe and Fittings
10. Section 46 05 10 – Disinfection of Water Systems.
11. Section 33 13 10 – Pipeline Pressure and Leakage Testing.
12. Section 40 05 58 – Process Valves.

1.02 REFERENCES

A. Reference Standards include, but are not limited to:

1. American Public Works Association (APWA) Utah Chapter Manual of Standard Specifications, latest Edition
2. ASTM A536 – Ductile Iron Castings.
3. ASTM B88 – Seamless Copper Water Pipe.
4. ASTM D3139 – Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals.

5. ANSI/AWWA C104/A21.4 – Cement-Mortar Lining for Gray-Iron and Ductile-Iron Pipe and Fittings for Water.
6. ANSI/AWWA C105/A21.5 – Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids.
7. ANSI/AWWA C110/A21.10 – Gray-Iron and Ductile-Iron Fittings, 3-Inch through 48-Inch, for Water and Other Liquids.
8. ANSI/AWWA C111/A21.11 – Rubber Gasket Joints for Gray-Iron and Ductile-Iron Pressure Pipe and Fittings.
9. ANSI/AWWA C150/A21.50 – American National Standard for Thickness Design of Ductile-Iron Pipe.
10. ANSI/AWWA C151/A21.51 – Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids.
11. ANSI/AWWA C153/A21.53 – Ductile-Iron Compact Fittings, 3-Inch through 12-Inch, for Water and Other Liquids.
12. AWWA C509 - Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems.
13. AWWA C550 - Standard for Protective Epoxy Interior Coating for Valves and Hydrants.
14. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
15. AWWA C605 - Underground Installation of PVC Pressure Pipe and Fittings.
16. AWWA C800 - Standard for Underground Service Line, Valves, and Fittings.
17. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4-inch through 12-inch, for Water.
18. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14-inch through 48-inch, for Water Transmission and Distribution.
19. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for water distribution.
20. ASTM D1784 - Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds.
21. ASTM D1785 - Poly (Vinyl Chloride) Plastic Pipe, Schedules 40, 80, and 120.
22. ASTM D2241 - Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
23. ASTM D2466 - Poly (Vinyl Chloride) (PVC) Plastic Pipe fittings, Schedule 80.
24. ASTM F2306 – 12-inch to 60-inch Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.
25. ASTM F2648 – 2-inch to 60-inch Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.
26. ASTM F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe
27. ASTM D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

28. NSF Standard No. 14, 60, and 61 - National Sanitation Foundation.
29. WW-T-779c – Federal Specifications
30. AWWA C502 – Dry Barrel Fire Hydrants.
31. AWWA C504 – Rubber-Seated Butterfly Valves.

1.03 SUBMITTALS

- A. Submit Shop Drawings per Section 01 33 00 – Submittal Procedures, for all pipe and fittings indicating: Name of Manufacturer, Materials, Standard Dimensions, References, Joint Data, maximum loadings, and thrust restraints.
- B. Provide a list of materials and corresponding suppliers.
- C. Submit Affidavit of Compliance certifying that materials furnished have been tested and are in compliance with specification requirements.
 1. Submit design calculations for structural design of pipe thickness where pipe class or thickness is not specifically called out.
- D. Product Data: Provide data on pipe materials, pipe fittings, valves and accessories.
- E. Manufacturer's Instructions: For valves, hydrants, and specialties, furnish in accordance with Sections 01 61 00 – Common Product Requirements, and 01 77 00 – Closeout Procedures, manufacturer's printed instruction for delivery, handling, storage, assembly, installation, adjustment, special tool requirements, and maintenance requirements.
- F. In accordance with Section 01 77 00 – Closeout Procedures, provide records of measured depths of water mains, service leads, valves, connections, transition couplings, adapters, thrust blocking; measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements; measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work; field changes of dimension and detail.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with Section 01 45 00 – Quality Control.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.05 FIELD MEASUREMENTS

- A. The Drawings indicate required pipe sizes and the general arrangement for major piping. Locations shall be verified in the field by the Contractor. Valves, fittings, and appurtenances shall be of such dimensions to allow for the installation of this piping substantially as shown on the Drawings. In the event it should become necessary

to change the location of any of the work due to interference with other work, Contractor shall consult with the Engineer prior to making any changes and all such changes shall be made at no additional cost to the Owner.

- B. Prior to roughing in any facilities or installation of piping and equipment, consult all related drawings including general, mechanical, electrical, etc., and inform self of materials, locations of structures, pipes, duct banks, electrical conduits, etc., which may impact the installation.
- C. Discrepancies discovered before or after work has started, shall be brought to the attention of the Engineer immediately, and the Engineer reserves the right to require minor changes in the work to eliminate such discrepancies.
- D. Pipe connections to equipment shall be subject to approval of Engineer and coordinated to meet the manufacturer's recommendations and requirements.
- E. No work that connects directly to equipment shall be installed before complete shop drawings of said equipment have been reviewed and approved by the Engineer.

1.06 PROJECT CONDITIONS

- A. Verify all dimensions of and between existing structures and locations of existing piping and equipment required for the proper installation of all new piping and equipment.
- B. Contractor shall be responsible for verification of location of all existing piping and structures. Potholing and or excavation to expose existing piping, conduits, etc. may be required prior to installation of new piping or connection to existing piping. Adjustments to the locations of new piping may be required due to locations of existing piping and sequencing of construction that will be required. Adjustments required shall be at no additional cost to the Owner.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivered materials shall be stockpiled and stored at locations approved by the Owner until required for installation. Materials shall be transported, delivered, stored, and handled in accordance with Manufacturer's instructions and the requirements of Section 01 61 00 – Common Product Requirements.
- B. Contractor shall inspect materials upon delivery for loss or damage in transit. Contractor shall be responsible for the replacement of damaged materials; damaged materials shall be removed from the Site.

1.08 REGULATORY REQUIREMENTS

- A. All products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National

Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each product. **ALL WATER APPURTENANCES SHALL BE CERTIFIED LEAD FREE.**

PART 2 PRODUCTS

2.01 REACTION BACKING (THRUST BLOCKS)

- A. Conform to details shown on Plan 561 and 562 of American Public Works Association (APWA) Utah Chapter Manual of Standard Specifications, latest Edition
- B. 3,000 psi concrete for pipe, fittings, and plugs unless specifically shown otherwise on Drawings.
- C. Locking restraint devices shall be used in conjunction with concrete thrust blocking.

2.02 BEDDING AND BACKFILLING

- A. Materials: As specified in Section 31 23 33 for backfill and pipe bedding.
- B. Aggregate Bedding: As specified in Section 32 05 16.

2.03 VALVES

- A. Gate Valves (4-inches to 20-inches in diameter):
 - 1. Minimum working pressure of 350 psi for 4-inch to 20-inch valves.
 - 2. Valve body and EPDM encapsulated wedge constructed of ductile iron or cast iron.
 - 3. All gaskets, seals, seats shall be compatible with Chloramines. Manufacturer shall submit compatibility information for gasket, seals, seats, etc for Engineer's review.
 - 4. Resilient seat gate, bubbletight closure design.
 - 5. Meet or exceed the ANSI/AWWA C509 standards.
 - 6. Bronze stem and stem nut.
 - 7. Fusion Bonded Epoxy-coated interior and exterior in accordance with AWWA C550.
 - 8. Equipped with non-rising stem with 2-inch square operating nut, open left (counterclockwise) rotation.
 - 9. Provide adjustable valve box, riser, and cover. Provide stem extensions for all actuators. Extension length will vary with the depth of bury for each valve and shall extend to within one (1) foot of top of valve box. Provide all necessary appurtenances for complete operation of valve.

10. Provide polyethylene encasement conforming to ANSI/AWWA C105/A21.5 for buried valves, as specified.
11. Connections: Mechanical joint, unless otherwise specified.
12. Provide gaskets, non-asbestos ring style gaskets, rated for the appropriate test pressure, and compatible with chloramines.
13. Provide Stainless Steel Type 304 nuts and bolts. All tie rod type restraints shall be stainless steel.
14. Markings shall be cast on the bonnet or body of each valve and shall show the manufacturer's name or mark, year valve casting was made, size of valve, and the designation of working water pressure.
15. Manufacturer shall furnish an affidavit stating that the valve and all materials conform to the applicable AWWA requirements and all tests specified under the respective standard have been performed and have been met. Valves shall be NSF 61 certified.
16. Contractor shall provide the Owner one valve wrench for the first valve installed and one wrench for every additional five valves installed.
17. Approved manufacturers for valves:
 - a. Mueller Company
 - b. Clow Valve Company
 - c. Approved Equal.

B. VALVE BOXES

1. Valve boxes shall be three-piece cast iron with a round base, Tyler Union or approved equal.
2. The top of the valve boxes shall be 5 ¼ inches in diameter.
3. Valve box height shall be suitable for the burial depth of the valve, installed plumb, with poly wrap encasement, and shall have sufficient length to permit at least 6-inches of adjustment above and below grade when the valve is laid to the specified depth. Adjustment shall be screw type.
4. Covers shall have the word "JVWCD" cast on top.
5. All buried valves shall have a full operator extension, as required to allow for operator use.

2.04 APPURTENANCES

A. Transition Couplings:

1. Long pattern, sleeve type, ductile iron couplings, meeting the requirements of ANSI/AWWA C110/A21.10 and rated for 250 psig.
2. Epoxy or nylon coated inside and out.
3. Where pipes of dissimilar metal are joined, ensure dielectric insulation to prevent galvanic corrosion.
4. Install with stainless steel bolts.
5. Provide polyethylene encasement.

6. Approved manufacturers:
 - a. Power Seal
 - b. Ford
 - c. Romac
 - d. Approved equivalent

B. Flanged Coupling Adapters:

1. Restrained flange adapters shall be made of ductile iron conforming to ASTM A536 and have flange bolt circles that are compatible with ANSI/AWWA C110/A21.10.
2. Restraint for the flange adapter shall consist of a plurality of individual actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of gripping wedges.
3. The flange adapter shall be capable of deflection during assembly, or permit lengths of pipe to be field cut, to allow a minimum of 0.6" gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
4. The inner surfaces of the couplings shall be prepared for coating in accordance with the instructions of the coating manufacturer and shall then be coated with liquid epoxy in accordance with ANSI/AWWA C210. The remaining surfaces, except the flange mating surfaces, shall be cleaned and shop primed with universal primer.
5. Approved manufacturers:
 - a. MegaFlange Series 2100.
 - b. Smith-Blair "Type 912", with anchor studs.
 - c. Approved Equivalent.

C. Flanged Dismantling joints

1. Standard - Meet or exceed AWWA Standard C219 coupling specification
2. FLANGED SPOOL: AWWA C207 Class D or E Steel Ring Flange, compatible with ANSI Class 125 and 150 bolt circles. Flange shall be rated for test pressure listed in Construction Drawings.
3. END RING AND BODY: ASTM A36 steel.
4. GASKETS: NBR Compounded for water and sewer service meeting the requirements of ASTM D 2000.
5. BOLTS AND NUTS: Stainless Steel, Types 304 or 316.
6. TIE RODS: Stainless steel, type 304 or 316
7. COATINGS: All surfaces coated including flange faces in fusion bonded epoxy, NSF 61 certified.
8. Assembly tolerances:
 - a. 12-inches and smaller: 2-inches
 - b. 14-inches and larger: 3-inches

9. Approved Manufacturer:
 - a. Romac DJ400.
 - b. Approved Equivalent
- D. Nuts and Bolts: Buried and non-buried applications, provide AISI 304 Stainless Steel bolts and AISI 304 Stainless Steel nuts, for all nuts and bolts on fittings, valves, hydrants, and transition couplers. Properly lubricated bolts to prevent seizing.
 1. Where stainless steel fasteners come in contact with aluminum, ductile iron, or other dissimilar metals, separate or isolate bolts and nuts from dissimilar metals with sleeves and washers.
 - a. Sleeves: Mylar, 1/32 inch thick, of proper size to fit bolts. One sleeve required for each bolt.
 - 1) Manufacturer:
 - 1) Central Plastics Company, Shawnee, Oklahoma.
 - 2) Or Equal.
 - b. Washers: 63 glass phenolic, 1/8 inch thick, of proper size to fit bolts. Two washers are required for each bolt.
 2. Prior to installing nuts, coat threads of stainless steel fasteners with the following anti-seize compound to prevent galling of threads.
 - a. Manufacturers:
 - 1) Never Seez Compound Corporation, Never-Seez.
 - 2) Oil Research, Inc., WLR No. 111.
 - 3) Or Equal.

E. TRENCH INSULATION

1. Trench insulation shall be extruded rigid board material. The insulation shall have a thermal conductivity of not more than 0.28 BTU per hour per square foot per degree Fahrenheit per inch of thickness as tested in accordance with ASTM C177. The insulation shall not absorb moisture to an extent greater than 2.5 percent by volume as tested in accordance with ASTM D2127. The compression strength of the insulation shall be greater than 20 psi as tested in accordance with ASTM D1621. The density of the insulation shall be between 0.9 and 1.3 pounds per cubic feet as tested in accordance with ASTM D1622.

PART 3 EXECUTION

3.01 GENERAL

- A. Contractor shall verify location of piping and piping systems as shown on the Drawings.

- B. Contractor shall be aware that it may be necessary to move a piping run a reasonable amount or shift it slightly up or down to avoid an existing obstruction or other piping runs. Contractor shall not receive additional compensation due to slight shift or movement of piping runs.
- C. Not all fittings may be shown on the Drawings, the fittings shown are meant to give a graphical representation only. Additional fittings required for differences in vertical and/or horizontal alignment may be required. Contractor shall not receive additional compensation due to additional fittings required to meet vertical and horizontal alignments.
- D. The Drawings show a two (2) dimensional graphical representation of the piping systems, Contractor shall note that there may need to be additional pipe length due to the vertical elevation differences that have not been represented on the drawings.
- E. Contractor shall provide the Owner with a minimum 48 hour notice on all requests to take a watermain out of service and shall be only at off-peak times.
- F. All joints shall be properly restrained in accordance with these specifications.
- G. Contractor shall provide dewatering as necessary; piping shall not be laid in water or wet conditions.
- H. See Section 31 23 33 for all trench excavation and backfill requirements, and piping system bedding requirements.
- I. See Division 40 for all exposed process piping and valves.

3.02 PREPARATION AND STORAGE

- A. Store pipe on-site on flat surface so barrel is evenly supported. Do not stack higher than 6 feet. Cover pipe with opaque material for extended storage.
- B. Remove scale and dirt on inside and outside before assembly. Inspect for damage to pipe and other materials before installation.

3.03 INSTALLATION – PIPE, VALVES, AND APPURTENANCES

- A. The type, kind, and class of pipe to be used shall be as shown on the Drawings. All pipes shall be laid and to the required line and grades.
- B. Install all pipe and appurtenances in strict accordance with manufacturer's recommendations.

- C. All foreign material or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench and it shall be kept clean by approved means during and after laying.
- D. Pipe materials shall be handled carefully. Damage to protective coatings, linings, and joint fittings shall be cause for rejection of the materials. Prior to installation each pipe section, fitting, or valve shall be thoroughly inspected by the Contractor to detect damage or defects. Contractor shall inform Engineer of such damage or defects. Any defective, damaged, or gravity piping which has had its grade or joint disturbed after layer shall be replaced.
- E. Cut pipe in a neat and workmanlike manner without damaging the pipe. Cutting of pipe for connections or pipe run lengths or inserting of fittings and valves shall be done in accordance with pipe manufacturer recommendations. Rough edges shall be removed and where rubber gasket joints are used, the outer edge shall be beveled by grinding or filing to produce a smooth fit.
- F. Trench preparation shall proceed in advance of pipe installation only so far as can be backfilled the same day, or as permitted by the Owners specifications.
- G. Excavate and backfill excavations and trenches in accordance with Section 31 23 33.
- H. Keep trenches free from surface and ground water until pipe jointing is complete.
- I. All fittings shall be set on cast in place or precast concrete blocks in order to prevent the weight from being transmitted to the pipe. Before concrete is placed around fittings and appurtenances, the appurtenance and pipe shall be wrapped with polyethylene to completely isolate the concrete from the water main construction.
- J. Form and place concrete for thrust blocking at each bend, tee, or change of direction. Thrust blocks shall bear on undisturbed earth.
- K. Securely close open ends of pipe and fittings when Work is not in progress.
- L. Pipe Installation:
 - 1. Install piping to lines, grades, and dimensions shown on Drawings.
 - 2. Take up and relay any pipe disturbed from its required grade or alignment.
 - 3. Install pipe to allow for expansion and contraction without stressing pipe.
 - 4. Install pipe such that maximum deflections from straight line or grade do not exceed manufacturer's specifications. Install bend fittings where maximum deflections are exceeded.
 - 5. Notify Engineer and Owner at least 48 hours in advance of service disruptions and connections.

- M. Prior to pipe placement the bedding conditions shall be such as to provide uniform and continuous support for the pipe. For belled pipe, bell holes shall be excavated as necessary to make the joint connections and provide proper support. Pipe shall not be laid in water or unsuitable bedding conditions. See Section 31 23 33 for bedding requirements.
- N. Piping shall be carefully lowered into laying position by the use of suitable restraining devices. The pipe shall not be dropped or dumped into the trench. All foreign matter or dirt shall be removed from the inside of the pipe and fittings before they are placed into position. Pipe joints shall be kept clean prior to and during installation. The joint surface shall be inspected prior to placement to ensure that there is no foreign matter, coating blisters, projections, rough edges, or damaged gaskets that may impact the integrity of the joint connection.
- O. As each length of pipe is placed in laying position the pipe shall be secured in place with approved backfill material and the appropriate compaction as specified in Section 31 23 33.
- P. Bell and spigot piping shall be laid with the bell ends facing upgrade and the laying shall start at the downgrade end and proceed upgrade, unless otherwise permitted by the Engineer.
- Q. When pipe laying is not in progress the open ends shall be closed by watertight plugs or other approved means. In the presence of water, the pipe end shall remain sealed until the trench has been properly drained or dewatered.
- R. At connections to existing piping, Contractor shall remove all dirt and debris that is allowed to enter the existing lines.
- S. Inspection: Do not cover pipe and fittings until all bedding, joints, and polyethylene wrap have been inspected.
- T. Replace any pipe, fittings, or appurtenances found defective after installation has been completed.
- U. PVC pipe used for force main and water main shall be installed in accordance with AWWA C605, AWWA Standard for Underground Installation of PVC Pressure Pipe and Fittings for Water.

3.04 PIPE THRUST RESTRAINT

- A. Provide all crosses, tees, bends, caps, and other thrust points in the piping system with suitable means of overcoming thrust.
- B. Concrete reaction blocking and/or retainer glands or tie rods may be used subject to the Engineer's approval. All rods, nuts, bolts, and hardware shall be stainless

steel. At tees, 90-degree bends, and dead ends, both mechanical type joint restraint and concrete reaction blocking shall be required.

- C. Pour concrete against undisturbed soil. Concrete must be allowed to cure in thrust restraints for 5 days before pressurizing water lines or have additional approved thrust restraints installed before pressurizing the water line.
- D. Pipe Joints: Do not cover with concrete. Leave completely accessible.
- E. Grease: Apply grease to all buried metal surfaces. Wrap with polyethylene sheet and tape wrap.
- F. Locking restraint devices shall be used in conjunction with concrete thrust blocking.

3.05 HYDROSTATIC PRESSURE TESTING

- A. Conduct pressure testing of the pipeline system in accordance with Section 33 13 10.

3.06 DISINFECTION OF POTABLE WATER SYSTEM

- A. Conduct disinfection of the pipeline system in accordance with Section 46 05 10.

3.07 POTABLE WATER SEPARATION

- A. Unless otherwise specified in Contract Documents, the potable water lines shall generally be placed with the minimum specified cover. However, a greater depth may be required to clear process piping and sanitary sewers and sewer services, and no additional compensation shall be provided for such adjustments.
- B. The horizontal distance between water lines and sanitary sewer lines shall be at least 10 feet. Where a water main and a sewer line must cross, the water main shall be at least 18 inches above the sewer line. Separation distances shall be measured edge-to-edge (i.e., from the nearest edges of the facilities).
- C. In locations where sewer is in direct conflict with existing water main and water services the water main and water services shall be lowered to provide at least 18 inches of vertical distance between the top of the water main or service and the bottom of the sanitary or relocated in accordance with the Drawings. No additional compensation will be made for lowering the water main.
- D. Water mains crossing above process piping or sanitary sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water main and the top of the sewer. When local conditions prevent a vertical separation as described, the following construction shall be used:

1. Sewers passing over or under water mains shall be constructed of materials equal to water main standards of construction for a distance of at least 10 feet on either side of the water main.
 2. Water main passing under sewers shall, in addition, be protected by providing:
 - a. A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water main.
 - b. Adequate structural support for the sewers to prevent excessive deflection of joints and settling on and breaking of the water mains.
 - c. A length of water pipe shall be centered at the point of crossing so that the joints will be equidistant and as far as possible from the sewer.
 - d. Water mains shall be laid at least 10 feet horizontally from any process piping, sanitary sewer, or storm sewer, whenever possible. When local conditions prevent a horizontal separation of 10 feet, a water main may be laid closer to sanitary sewer provided that:
 - 1) The bottom of the water main is at least 18 inches above the top of the sewer.
 - 2) Where this vertical separation cannot be obtained, the sewer shall be constructed of materials and with joints that are equivalent to water main standards of construction and shall be pressure tested to assure water tightness prior to backfilling.
- E. No deviation shall be made from the required line or grade except with the consent of the Engineer.
- F. The contractor shall refer to The Utah Department of Environmental Quality Administrative Code R309-550 Facility Design and Operation: Transmission and Distribution Pipelines for further information on separation of water main requirements.

3.08 DATA FOR AS-BUILT RECORDS

- A. Record stationing and/or ties of all fittings, valves, and other underground appurtenances installed on sheets provided for such purposes by the Engineer. Include invert or centerline elevations.

END OF SECTION

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SECTION 33 11 13
STEEL WATER TRANSMISSION PIPE

PART 1 GENERAL

1.01 DESCRIPTION

A. Section includes:

1. Specification for steel pipe of the sizes and in the locations shown on the drawings and as specified herein.
2. Specification for the method by which a Cement Mortar Lining is applied to the internal surfaces and a cement mortar lining is applied to the external surfaces of steel product pipe for the improvement of flow properties and protection from corrosion.
3. Specification to cover the on-site/field application of coatings and linings to the internal and external weld surfaces of product pipelines.

1.02 QUALITY ASSURANCE

A. Standards:

1. American Public Works Association (APWA) Utah Chapter Manual of Standard Specifications, latest Edition
2. Steel pipe 6 inches and larger: AWWA C200
3. Rubber gasket joints: AWWA C200
4. Cement mortar lining and cement mortar coating: AWWA C205
5. Field welding: AWWA C206
6. Steel pipe flanges: AWWA C207
7. Steel pipe fittings: AWWA C208
8. Steel pipe design and installation: AWWA M11
9. Liquid-Epoxy Coating: AWWA C210
10. Heat-Shrinkable Sleeves: AWWA C216
11. Above Ground Exterior Coating: AWWA C218
12. Bolted Sleeve-Type Mechanical Couplings: AWWA C219
13. Polyurethane Coating: AWWA C222
14. Split Sleeve Couplings: AWWA C227
15. Cement-Mortar Lining of Water Pipelines In Place – 4" and larger: AWWA C602
16. Specification for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and over): ASTM A 139
17. Steel Structures Painting Council.
18. Steel structures painting council standard for "Near white blast cleaning" (Equal standards are NACE 2, and SA 2-1/2).

19. Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe – 4-inch and Larger – Shop Applied.
20. Standard for Polyurethane Coatings for The Interior and Exterior of Steel Water Pipelines.
21. NSF Standard No. 61 National Sanitation Foundation.

B. Related Sections include, but are not limited to:

1. Section 01 11 00 – Summary of Work.
2. Section 01 33 00 – Submittals.
3. Section 01 45 00 – Quality Control.

1.03 SUBMITTALS

A. Prior to the start of manufacturing, the following shall be submitted to, and approved by the Engineer:

B. Shop Drawings shall be submitted to the Engineer for approval and shall include the following:

1. Details of standard pipe.
2. Calculations for pipe design and/or test data including fittings reinforcement.
3. Welder certifications and qualifications.
4. Details of stulling and shipping packaging.
5. Details of specials and fittings.
6. Copy of the manufacturer's quality control check of pipe material and production.
7. Line layout, laying schedule, and marking diagrams which indicate the specific number of fitting and the location and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints.

C. Material Certification: Provide certification of the steel product pipe material at the time of delivery to the site.

1. The pipe supplier shall furnish a certified affidavit of compliance for all product pipe and other products or materials furnished under this Section of the Specifications, as specified in ANSI/AWWA C200, and the following supplemental requirements:
 - a. Physical and chemical properties of all steel.
 - b. Hydrostatic test reports.
 - c. Results of production weld tests.

D. Lining and Coating Submittals

1. For each coating material provide manufacturer's data and application sheets.
 - a. Supplier's name, address, and phone number.
 - b. Purchase order number and date.
 - c. Manufacturer's designated product name.
 - d. Batch number(s) for each material, except thinners.
 - e. Quantities ordered for each material, except thinners.
2. Written evidence of applicator's qualifications.

1.04 QUALIFICATIONS

- A. The pipe supplier shall submit to the Owner with their bid evidence that the Supplier and the proposed manufacturing plant meet the following requirements:
1. ISO 9000 Certification and/or SPFA Quality Certification.
 2. Demonstrate current production capability for volume of work required for this project.
 3. Experience shall include successful fabrication of at least 100,000 lineal feet of 30 inch diameter or larger pipe, with wall thickness of 0.25 inches or greater, within the past five years with the type of joint specified and shall have been manufactured in the United States to AWWA C200, cement lined to AWWA C205, and polyurethane coated to AWWA C222.
- B. Qualify welding procedures and welders in accordance with AWWA C206 and the code under which welding is specified to be accomplished. The more stringent requirements shall apply.

1.05 HANDLING, STORAGE AND SHIPPING

- A. During loading, transporting, unloading, storing, and laying, prevent damage to steel pipe, linings, and coatings. Damaged pipe will be rejected by the Owner.
- B. Pipe shall be braced as required to maintain roundness of +/- 1 percent during shipping and handling. All pipe bracing shall remain in the pipe to maintain roundness until after installation of the pipe in the trench.
- C. Coated pipe shall be shipped on bunks and secured with nylon belt tied down straps or padded banding located approximately over braces. Use heavy padding under ties.
- D. Coated pipe shall be stored on padded skids, sand or dirt berms, sand bags, old tires or other suitable means so that coating will not be damaged.
- E. Support and store pipe above the ground surface. Do not allow bells and spigots to contact each other or the ground.

- F. Coated pipe shall be handled with the wide belt slings, padded forks, or other means that will not damage the pipe. Chains, cables or other equipment likely to cause damage to the pipe or coating shall not be used.
- G. Tightly close open ends of shop-applied, cement-mortar-lined pipe with plastic wrap for protection of cement-mortar lining during shipment and storage at the Jobsite.
- H. Plastic wrap at least two thicknesses of 6-mil sheet polyethylene plastic. Remain on pipe until installation.
- I. Repair damage to lining or coating as directed if, in the opinion of the Engineer, a satisfactory repair can be made; otherwise, replace damage section at the expense of the Contractor.
- J. Prior to shipment, the pipe shall be visually inspected for damage to the coating. Any damaged areas shall be repaired in accordance with the standard to which the coating was applied.

1.06 QUALITY CONTROL

A. Product Pipe:

- 1. Inspections: All pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of ANSI/AWWA C200, ANSI/AWWA C210, and ANSI/AWWA C222 as supplemented by the requirements herein.
- 2. Tests: Except as modified herein, all materials used in the manufacture of the product pipe shall be tested in accordance with the requirements of ANSI/AWWA C200, ANSI/AWWA C210, and ANSI/AWWA C222.
- 3. Welding Requirements: All welding procedures used to fabricate pipe shall be qualified under the provision of ANSI/AWS B2.1 or ASME Section IX. Welding procedures shall be required for, but not limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections. The welds shall be designed for the maximum design pressure of the pipeline, in-service external loads, temperature and environmental considerations, and for the forces created by the Contractor's proposed installation methods.
- 4. Welder Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used.
 - a. Shop Welders: Shall maintain current qualifications under the provisions of ANSI/AWS B2.1 or ASME Section IX.
 - b. Field Welders: Shall maintain current qualifications under the provisions of AWS D1.1. All welders to perform field welding for

the Project shall pass a qualification test. Machines and electrodes similar to those used in the Work shall be used in qualification tests. The welding contractor shall furnish all material and bear the expense of qualifying welders.

B. Manufacturer Hydrostatic Test:

1. Perform hydrostatic pressure tests in accordance with AWWA C200.

1.07 QUALITY REQUIREMENTS RELATED TO LININGS AND COATINGS

A. All work of this Section shall conform to ANSI/AWWA C205 and/or ANSI/AWWA C222.

B. Check cleanliness of pipe immediately prior to blasting.

C. Monitor the size, shape, dryness, and cleanliness of the blasting material and process.

D. Coating applicators qualifications:

1. Qualified to apply specified coating materials by one of the following:
 - a. Successfully completed training in use of coating material on applications similar to those specified in these specifications.
 - b. Skilled and experienced in application of coating materials similar to materials specified in these specifications under conditions similar to this project.

E. Compliance criteria for coating materials.

1. Material is of same composition and formulation to meet physical and performance test results for one of the following:
 - a. Submitted batch or previously tested batch materials complies with these specifications.
 - b. Submitted batch materials are unchanged from previously tested batch materials that complies with manufacturer's quality control (QC) and quality assurance (QA) programs.
 - c. Submitted batch materials complies with manufacturer's quality control (QC) and quality assurance (QA) programs as listed on product data and application sheets.

F. Check visually, in good light, the surface of the pipes for metal defects, dust, and surface debris.

G. Check pipe surface blast profile.

H. Check thickness of cured coating.

1.08 REFERENCED TECHNICAL DATA

- A. M11, Steel Pipe – A Guide for Design and Installation, fourth edition, prepared by the American Water Works Association, (AWWA).

PART 2 PRODUCTS

2.01 MATERIALS

- A. Spiral Weld Steel Pipe – 24-inch – 48-inch Nominal Diameter
 - 1. All steel shall be manufactured to meet ASTM A139, Grade C, minimum yield point of 36,000 psi and a minimum ultimate tensile strength of 60,000 psi.
 - 2. The minimum steel cylinder thickness shall be as indicated on Construction Drawings and not less than the nominal diameter divided by 120. The maximum allowable thickness variation for plat, sheet, or coil shall be in accordance with AWWA C200.
 - 3. Pipe shall be designed for pressure as indicated on Construction Drawings and field pressure testing of 1.5 times working pressure. Pipe design for internal pressure shall be in accordance with AWWA M11. Design stress shall be limited to 50% of the minimum specified yield strength at working pressure and 75% at the greater of working pressure plus field test pressure.
 - 4. Nominal pipe diameter is measured to the inside of the lining (inside diameter).
 - 5. Wall thickness, pipe diameter, and grade of pipe shall be stamped on the exterior of each pipe section.
 - 6. Pipe for use with couplings shall have ends prepared to meet the requirements of the coupling manufacturer.
 - 7. Standard pipe laying lengths shall be a minimum of 40 feet and a maximum of 50 ft with special lengths, field trim pieces and closure pieces as required by plan and profile for location of elbows, tees, reducers and other in-line fittings.
 - 8. Piping shall be furnished complete with all fittings, specials, jointing materials required for installation of valves and other appurtenances indicated on the drawings or otherwise required for proper installation of the piping.
 - 9. Coating and Linings (unless otherwise specifically noted on the Drawings):
 - a. Pipe shall be cement mortar lined in the shop by the centrifugal process in accordance with AWWA C205. Cement mortar lined pipe shall be braced as required to maintain roundness during shipping and handling and shall have ends capped prior to shipment. Pipe end caps shall remain in-place during storage

until the pipe is ready for installation. For pipe 14 inch nominal diameter and larger, the finished ID after lining shall be the nominal size. For pipe 12 inch nominal diameter and smaller, standard OD pipe sizes shall be furnished.

10. Pipeline Embedment and Trench Configuration
 - a. As specified in Specification Section 31 23 33 Trenching and Backfill and as shown on the Construction Drawings.

B. Spiral Weld Steel Pipe Fittings

1. Pipe material used in the fittings shall be of the same material and minimum thickness as the pipe. Fittings shall be equal in pressure design strength and shall have lining and coating as specified.
2. All fittings shall have the wall thickness increased so that the combined stresses due to internal pressure (circumferential and longitudinal) and bending will not exceed 67 percent of the yield strength of the pipe material.
3. Wall thicknesses of the reducing sections shall not be less than the required thicknesses for the larger ends.
4. Whether or not indicated on the Drawings, additional wall thickness shall be provided as required to ensure that the combined stresses do not exceed the specified maximum. Unless otherwise indicated or directed, the internal pressure shall be the specified field test pressure for the piping adjacent to the time in question.
5. Special fittings shall be plant fabricated from ASTM A139 Grade C steel with a minimum yield strength of 36,000 psi. Flanges and blind flanges shall be Class E conforming to AWWA C207.
6. Fittings shall conform to the dimensions of AWWA C208 or may be fabricated into standard or special pipe lengths. Elbows up to 22 ½ degrees shall be two piece; over 22 ½ degrees through 45 degrees shall be three pieces; over 45 degrees through 67 ½ degrees shall be four pieces; and over 67 ½ degrees through 90 degrees shall be five pieces. Elbows shall have a minimum radius of 2 ½ times the pipe O.D. All tees, laterals and outlets shall be reinforced in accordance with AWWA M11.

C. Blind Flanges

1. Shall be in accordance with AWWA C207, unless otherwise indicated on the Drawings or specified.

D. Joints

1. Gasketed Joints: Push-on joints with a minimum stab depth of 5 1/2-inch may be used for pipe where welded joints are not required for thrust restraint. All other joints shall be welded.

- a. Push-on joints shall be designed for a test pressure of at least 250 psi, and a working pressure of 150 psi. The standard joint shall be rubber gasketed unless otherwise noted on the plans. Gasketed joints shall conform to AWWA C200 Standard and be rolled groove type. Rolled groove gasketed joints shall consist of a flared bell end formed and sized by the use of a segmental expander or by forcing the pipe end over a plug die. The spigot end groove, designed to retain the rubber gasket, shall be formed and sized by rolling on male-female dies to match the bell. The difference in diameter between the I.D. of bell and the O.D. of the spigot shoulder at point of full engagement, with allowable deflection, shall be no more than 0.04 inches as measured circumferentially.
 - b. The gasket shall have sufficient volume to approximately fill the area of the groove and shall conform to AWWA C200.
 - c. The joint shall be suitable for the pressures of the class of pipe on which it is furnished, and shall operate satisfactorily with a deflection, the tangent of which is not to exceed 0.75 inch/D where D is the outside diameter of the pipe in inches or with a uniform pull-out of $\frac{3}{4}$ inch.
 - d. Rubber gasketed joints may be furnished only by a manufacturer who has furnished pipe with joints of similar design for comparable working pressure, pipe diameter, pipe length, and wall thickness.
 - e. Shop applied coating shall be continuous to the end of the pipe on the bell end and shall be held back on the spigot end sufficiently to allow full engagement of the joint. Shop applied lining shall be continuous to the end of the pipe on the spigot end and shall be held back on the bell end to the point of maximum engagement or further as recommended by the manufacturer. For gasketed joints, the exposed surfaces of the bell and spigot shall be painted with one shop coat of a holding primer.
2. Lap-Welded Joints shall be used at bends and as shown in the Drawings for restrained lengths. Joints and welding shall be in accordance with AWWA C206. The joint shall be welded with a single full-depth fillet weld on either the inside or the outside of the pipe.
 - a. The bell shall provide for a nominal lap such that the minimum engagement, with 1 inch allowable pull, is at least 1 inch or three times the thickness of the bell, whichever is greater.
 - b. Shop applied lining and coating shall be held back sufficiently to allow for welding of the joint, except that lining shall be continuous to the end of the spigot for pipe diameters 24 inches and smaller.
 - c. A 3-inch or 4-inch diameter tap hole shall be provided for every 300 lineal feet of restrained joint (welded) steel pipe for the welding operation if interior welds are utilized. The tap hole shall be completely sealed by welding upon completion of the pipe joint welding operations.
 3. Harnessed Restrained Joints shall be used at locations indicated on the Drawings.

- a. Joints shall be in accordance with AWWA M11.
 - b. Bolts and nuts for buried and submerged flanges and flanges located outdoors above ground or in open vaults in structures shall be Type 316 stainless steel.
 - c. Harness lugs shall be spaced equally around the pipe. It may be necessary to reinforce the pipe wall locally to the harness assembly to resist pipe distortion.
 - d. Shop lining and coating shall be continuous to ends of pipe and around the lugs.
 - e. Shall conform to the details as indicated on the drawings.
 - f. Lugs and collars shall be shop welded to the pipe and coated as specified for the pipe.
4. Couplings: Utilize epoxy coated joint couplings where indicated on the plans shall be Dresser, Victaulic Depend-O-Lok, Smith Blair, Baker or equal.
- a. Couplings for buried service shall have all metal parts painted with epoxy paint conforming to AWWA C210 or C213.
5. Flanges:
- a. Flanges shall be in accordance with AWWA C207 Class D for pressures to 175 psi on 4 inch through 12 inch diameter, and 150 psi on diameters over 12 inches.
 - b. Flanges shall be AWWA C207 Class E for pressures over 150 psi to 275 psi when mating steel to steel; or shall be AWWA C207 Class F for pressures to 300 psi (drilling matches ANSI B16.5 Class 250).
 - c. Shop lining and coating shall be continuous to ends of pipe and backs of flanges.
 - d. Gaskets: Gaskets shall be furnished in accordance with AWWA C207, ring type, John Crane "Style 4160" compressed aramid fiber sheet, non-asbestos, 1/16th inch thick, for field test pressures above 250 psi.
 - e. Bolts and nuts for flanges located indoors and in enclosed vaults and structures shall be stainless steel 304, in accordance with AWWA C207.
 - f. Bolts and nuts for buried and submerged flanges and flanges located outdoors above ground or in open vaults in structures shall be Type 304 stainless steel. For all buried flanges located in non submerged conditions, bolts shall conform to ASTM A193, Grade B7, hot dipped galvanized A153, and nuts shall conform to ASTM A194, Grade B7, 2H, hot dipped galvanized ASTM 153.
 - g. Insulation flanges shall be used in locations designated on the Drawings or connection to dissimilar metals as directed by the Engineer.
 - 1) Flanges as specified herein, except bolt holes shall be enlarged as required to accept bolt insulating sleeves.
 - 2) Insulation kits: As manufactured by Central Plastics or PSI Industries.

- 3) Insulating Gaskets: Type E. pyrox 1E glass reinforced epoxy, 1/8 inch thick, with Buna-N sealing element.
- 4) Bolt Insulating Sleeves: Mylar, 1/32 inch thick.
- 5) Insulating Washers: Phenolic laminate, 1/8 inch thick, one for each flange bolt.
- 6) Backing Washers: Steel, 1/8 inch thick, two for each flange bolt.

6. Access Manholes

- a. Access manholes shall be provided as shown in the locations on the Drawings. Each access manhole shall consist of a 24-inch flanged outlet, coated with a blind flange in an assembly as shown in the Drawings.

E. Field Welding

1. All welds shall be sound and free from embedded scale or slag, shall have tensile strength across the weld not less than that of the thinner of the connected sections, and shall be watertight.
2. Butt welds shall be used for all welds in the fabrication of fittings, bends and other specials.
3. Fillet welds shall be used for flange attachment in accordance with AWWA C207.
4. All welding procedures, welders, welding operators, and tackers shall be qualified in accordance with AWS D1.1 and as defined in Section 3 of AWWA C206 or AWWA C200, as applicable. All qualifications shall be all position pipe test as defined by Section 5 of AWS D1.1.

F. Shop-applied Internal Cement Mortar Lining Materials

1. Clean and cement mortar line steel pipe and fittings in accordance with AWWA C205 and these specifications. Portland cement shall be ASTM C150 Type II or Type II/V modified. Shop apply NSF approved cement mortar lining for water service. Internal linings and coatings for water lines and appurtenances shall be NSF approved for potable water service.
2. Provide cement mortar lining of uniform thickness at pipe and joints. Minimum steel cement mortar lining thickness shall be in accordance with AWWA C205 for nominal pipe diameter per the following table.

Nominal Steel Pipe & Fitting Size (inches)	Minimum Thickness of Linings (inches)	Tolerance (inches)
4" to 10"	1/4"	-1/16", +1/8"

11" to 23"	5/16"	-1/16", +1/8"
24" to 36"	3/8"	-1/16", +1/8"
Over 36"	1/2"	-1/16", +1/8"

G. Field Applied Joint Coating Materials

1. All joints, including welded joints and bell and spigot joints, shall be coated in accordance with the jointing materials listed here.
 - a. Use of the following repair methods, as modified herein, may be used to repair shop applied coatings and coat external girth weld joints.
 - b. Heat shrink sleeve coating type systems may be used that are compatible with the existing pipe coating system for field pipe joint coating suitable for the intended service and in accordance with this specification and AWWA C216.
 - c. Provide heat shrink sleeve with a cross-linked polyolefin wrap or sleeve with a mastic sealant. Sleeve shall be a minimum of 85 mils recovered total thickness. Sleeve shall completely enclose pipe or fitting with no gaps or voids.
 - d. Heat shrink sleeves shall provide a minimum adhesion of 40-pounds per lineal inch width or printed acceptance values according to manufacturer's data sheets, which ever is higher.
 - e. Provide suitable primer type if recommended by the heat shrink sleeve manufacturer.
 - f. Provide only propane torches or wrap-around heaters for pipeline shrink sleeves as recommended by heat shrink sleeve manufacturer.
 - g. Verify that application of heat shrink sleeve will not damage interior coatings. Special care shall be taken for pipelines with non-cementitious linings. Contractor shall repair all damage to internal or external coatings.
 - h. Color as determined by Engineer.
 - i. bonding per pipe and joint size and type.
 - j. Approved Materials and Manufacturers:
 - 1) Aqua-Shield Aqua-Sleeve Standard Type, with 40 percent recovery, 105 mils recovered thickness, blue color by CANUSA.
 - 2) Raychem Water Wrap Pipe Sleeve, with 28 percent recovery, 88 mils recovered thickness, blue color, by Tyco Raychem/Polyken
 - 3) Approved Equal.

PART 3 EXECUTION

3.01 INSPECTION AND TESTING

- A. All pipe shall be inspected and tested at the manufacturing facility.

- B. Hydrostatic testing shall be completed in accordance with AWWA C200.
- C. The Owner shall have the right to have any or all piping, fittings, or specials inspected and tested by an independent testing agency at the manufacturing facility or elsewhere. Such inspection and testing will be at the Owner's expense.
- D. Mark as rejected and immediately remove from the jobsite, or repair to the Owner's satisfaction, all pipe lengths exhibiting signs of damage to the lining, coating, joints, or pipe wall.
- E. Field welded pipe shall be tested in accordance with AWS procedures. All field welded joints shall be tested per Section 01 45 00. Frequency of testing may be reduced based on welding performance, as determined by Engineer.

3.02 REPAIR OF DAMAGED SURFACES

- A. Repair items, equipment, or surfaces which are damaged or contaminated as directed by the Engineer
 - 1. Repair damaged items or restore manufacturer-coated equipment to original condition and appearance.
 - 2. Before coating any damaged coated surfaces, re-clean exposed surface and apply coating materials in accordance with these specifications.

3.03 INSTALLATION

- A. The Contractor shall provide and install all required piping and accessories in accordance with the Contract Documents and manufacturer's recommendations. Pipe installation as specified in this section supplements AWWA M11.
- B. Joint assembly
 - 1. Gasketed joints
 - a. Install the gasket and assemble the joint in accordance with the pipe manufacturer's recommendations.
 - b. Electrically bond the joint as required in these specifications.
 - c. Coat the joint exterior by application of either a heat shrinkable sleeve conforming to AWWA C216, or cold applied tape conforming to AWWA C217. The thickness of the heat shrinkable sleeve shall be 85 mil minimum, or as recommended by the sleeve manufacturer, whichever is greater. The cold applied tape shall consist of two wraps of 35 mil tape for a total thickness of 70 mils.
 - d. Coat the joint interior by mortaring the annular space with a stiff mix of non-shrink grout. The finished joint shall be smooth and flush with the adjacent interior pipe surface. The lining shall be repaired in accordance with AWWA C205.
 - 2. Lap field welded joints

- a. Wire brush exposed end of joint surfaces
 - b. Insert the plain end into the expanded bell such that the minimum overlap at any location around the joint circumference is in accordance with AWWA C206.
 - c. A single full fillet weld shall be provided by certified welders qualified in accordance with AWS D1.1. Where installed in casing pipe, or otherwise noted on the plans, joint shall be provided with a full fillet weld and a seal weld to allow an air test of the joint through a threaded outlet provided by the pipe manufacturer. Air-test the joint in accordance with AWWA C206. The threaded outlet shall be plugged following a successful air test.
 - d. Complete linings and coatings as specified in 3.02.B.1.c or d, as applicable.
3. Flanged joints
- a. Assemble flanged joints in accordance with AWWA M11.
 - b. Execute care when tightening joints to prevent undue strain upon valves, pumps, and other equipment.
 - c. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
4. Mechanical joints
- a. Mechanical joints shall be installed in accordance with the manufacturer's recommendations.

C. Installing Buried Piping

- 1. Inspect each pipe and fitting before lowering the buried pipe or fittings into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field with material compatible with the original. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.
- 2. Handle pipe in a manner to avoid any damage to the pipe. Pipe shall be hoisted from the trench by means of wide-belt slings. Metal chains, cables, tongs, or other equipment likely to cause damage to the coating shall not be permitted. Do not drop or dump pipe into trenches under any circumstances.
- 3. When installing piping in trenches, do not deviate more than one inch from line or ¼ inch from grade. Measure for grade at the pipe invert.
- 4. Grade the bottom of the trench and place a 4 inch minimum layer of bedding material under the pipe. Before installing each section of the pipe, check the grade with a straight edge and correct any irregularities found. The trench bottom shall form a continuous and uniform bearing and support for the pipe at every point between bell holes, except that the grade may be disturbed for the removal of lifting tackle.

5. At the location of each joint, dig bell (joint) holes in the bottom of the trench and at the sides of dimensions to permit visual inspection of the entire joint and welding if required.
6. Keep the trench in a dewatered condition during pipe installation.
7. When the pipe installation is not in progress, close the open ends of pipe. DO NOT permit trench water, animals, or foreign material to enter the pipe.
8. Install trench plugs per plans and specifications.

3.04 MATERIAL SUPPLIER SERVICES

- A. The steel pipe and fitting material supplier shall provide the services of a Technical Manager. The Technical Manager shall make periodic site visits to the Jobsite as described in Specification Section 01 31 00 – Coordination and Meetings.

END OF SECTION

SECTION 33 11 14
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:
2. Pipe, fittings, wall pipes, connections, and gauges associated with:
 - a. Ductile Iron Pipe and Fittings.
 - b. Flange Insulating Gasket Kits.
 - c. Polyethylene Tubing.

B. Related section include:

1. Section 00 73 40 – Funding Agency Requirements.
2. Section 01 33 00 – Submittal Procedures.
3. Section 01 45 00 – Quality Controls.
4. Section 01 61 00 – Common Product Requirements.
5. Section 01 75 00 – Starting and Adjusting.
6. Section 01 77 00 – Closeout Procedures.
7. Section 01 78 23 – Operations and Maintenance Data.
8. Section 01 79 00 – Demonstration and Training.
9. Section 09 96 00 - High Performance Coatings
10. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping
11. Section 40 05 07 - Hangers and Supports for Process Piping
12. Section 40 05 58 - Process Valves
13. Section 40 05 97 - Identification for Process Equipment
14. Section 40 46 16 - Coatings for Process Protection

1.02 QUALITY ASSURANCE

- A. The equipment and material to be furnished under this Contract shall be in accordance with Section 01 45 00 Quality Controls and Section 01 61 00 Common Product Requirements.
- B. Piping modifications subject to Engineer's review. No additional compensation allowed for modifications required to suit equipment furnished by Contractor.

1.03 REFERENCES

- A. Reference Standards include:

1. American Public Works Association (APWA) Utah Chapter Manual of Standard Specifications, latest Edition
2. ANSI/AWWA C104/A21.4: Cement-Mortar Lining for Gray-Iron and Ductile-Iron Pipe and Fittings for water.
3. ANSI/AWWA C105/A21.5: Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for water and other liquids.
4. ANSI/AWWA C110/A21.10-98: Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm Through 1,219 mm), for Water.
5. ANSI/AWWA C111/A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
6. ANSI/AWWA C115/A21.15: Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
7. ANSI/AWWA C150/A21.50: Thickness Design of Ductile-Iron Pipe.
8. ANSI/AWWA C151/A21.51: Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sand Lined Molds for water or other liquids.
9. ANSI/AWWA C208: Dimensions for Fabricated Steel Water Pipe Fittings.
10. ANSI/AWWA C219: Bolted, Sleeve-Type Couplings for Plain-End Pipe.
11. AWWA C600-10: Installation of Ductile-Iron Water Mains and Their Appurtenances.
12. AWWA C606-11: Grooved and Shouldered Joints.
13. AWWA C651-05: Standard for Disinfecting Water Mains.
14. AWWA C653-03: Disinfection of Water Treatment Plants.
15. NSF Standards No. 60 and 61: National Sanitation Foundation.

1.04 SUBMITTALS

- A. Submit Shop Drawings in accordance with Section 01 33 00 for all pipe and fittings indicating: Name of Manufacturer, Materials, Standard Dimensions, References, and Joint Data.
- B. Line layout, laying schedule, and marking diagrams which indicate the specific number of fitting and the location and the direction of each fitting in the completed line for piping 6" and larger. In addition, the line layouts shall include: the pipe station and invert elevation at all changes in grade or horizontal alignment; all elements of curves and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints.
- C. Submit Affidavit of Compliance for ductile iron pipe and fittings. The affidavit letter from the pipe and fitting manufacturers shall include stating the product(s) are supplied new from the manufacturer and all linings required by the specification for the pipe or fittings are supplied by the manufacturer and are covered by the manufacturer's warranty.

- D. Submit design calculations for structural design of pipe thickness where pipe class or thickness is not specifically called out.
- E. Grooved/shouldered joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified with the applicable style or series designation.
- F. Submit written certification from the grooved/shouldered component manufacture that all grooved/shouldered components (couplings, fittings, valves, gaskets, bolts and nuts) are of the same manufacture and grooving tools are of the same manufacturer as the grooved/shouldered components.
- G. Operations and Maintenance Data shall be submitted in accordance with specification Section 01 78 23.
- H. Certification that all materials in contact with treated or potable water are ANSI/NSF 61 approved.

1.05 PAINTING AND IDENTIFICATION SYSTEMS

- A. All material and equipment in this section shall be factory primed. Primer shall be compatible with finish coats of paint provided under Section 40 46 16 - Coatings for Process Protection.
- B. The Contractor shall refinish and restore to the original appearance all equipment that has sustained damage to the manufacturer's finish or prime coats of paint or enamel.
- C. Finish painting of all materials and equipment in this Section shall be the responsibility of the Contractor, and shall be as described in Section 40 46 16, unless otherwise specifically indicated.
- D. Provide process pipe identification per Section 40 05 97 - Identification for Process Equipment.

1.06 REGULATORY REQUIREMENTS

- A. All Products that may come into contact with water intended for use in a Public Water System shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

1.07 WARRANTY REQUIREMENTS

- A. A written warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period identified herein and shall begin from the date of Final Completion, as defined in Section 01 77 00. Such warranty shall cover all defects or failures of materials or workmanship that occur as the result of normal operation and service. No prorated warranty will be accepted.
 - 1. Contractor 's Warranty: One (1) Year.
 - 2. Manufacturer's Warranty: Minimum of one (1) year but not less than manufacturer's standard warranty period.

PART 2 PRODUCTS

2.01 DUCTILE IRON FITTINGS

- A. Approved Manufacturers
 - 1. American Cast Iron Pipe Company
 - 2. McWane/Tyler Ductile
 - 3. U.S. Pipe
 - 4. Sigma Corporation
 - 5. Star Pipe Products
 - 6. EBAA Iron, Inc.
 - 7. Or Approved Equal
- B. Fittings
 - 1. Fittings shall be in accordance with AWWA/ANSI C110/A21.10, AWWA/ANSI C153/A21.53.
 - 2. Fittings for potable water service shall meet requirements of NSF 61.
 - 3. Fittings at a minimum shall meet or exceed the pressure classes of the pipe which the fitting is connected, unless specifically indicated on the drawings.
- C. Fittings Markings
 - a. Meet the minimum requirements of AWWA/ANSI C151/A21.51
 - b. Minimum Markings shall include:
 - 1) "DI" or "Ductile" cast or metal stamped on each fitting
 - 2) Applicable AWWA/ANSI standard for that fitting
 - 3) Pressure rating
 - 4) Number of degrees for all bends
 - 5) Nominal diameter of the openings

- 6) Year and country fitting was cast
 - 7) Manufacturers mark
2. Joints
- a. Push-On Joints
 - 1) Comply with AWWA/ANSI C111/A21.11
 - b. Mechanical Joints
 - 1) Comply with AWWA/ANSI C111/A21.11
 - c. Mechanical Joints with mechanical restraint.
 - 1) Restraint devices shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110-A21.10.
 - 2) The devices shall have the following working pressure ratings based on size and type of pipe:
 - 1) Ductile Iron Pipe
 - (1) 3" – 16", 350 psi
 - (2) 18" – 48", 250 psi
 - (3) 54", 200 psi
 - 2) PVC C900 and C905 (1) 3" – 16", 235 psi
 - 3) Ratings are for water pressure and must include a minimum safety factor of 2:1 in all sizes.
 - 4) Restraint devices shall have specific designs for ductile iron and PVC and should be easily differentiate between the two.
 - 5) Gland body, wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
 - 6) Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly.
 - 7) Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
 - 8) Bell restraint harnesses shall NOT be used with Ductile iron pipe.
 - d. Push-On Restrained Joints
 - 1) Restraining Push-On Joints by means of a special gasket.

- 2) Pressure rating shall exceed the working and test pressure of the pipeline
- 3) Approved Manufacturers Products:
 - 1) Flex-Ring Joint Pipe – Contractor shall note that all existing Ductile Iron Pipe fittings scheduled for points of connections were installed with Flex-Ring Fittings. Contractor shall verify prior to construction.
 - 2) Lok-Ring Joint Pipe
 - 3) TR Flex Joint Pipe
 - 4) HP Lok Joint Pipe
- e. Push-On Restrained Joint bell and spigot
 - 1) Pressure rating shall exceed the working and test pressure of the pipeline
- f. Flanged Joints
 - 1) AWWA/ANSI C115/A21.15
 - 2) Flange bolt circles and bolt holes shall match those of pipe
 - 1) Field fabricated flanges are prohibited
- 3. Gaskets
 - a. See Ductile Iron Pipe
- 4. Bolt and Nuts
 - a. See Appurtenances section in this specification.
- 5. Ductile Iron Fittings Exterior Coatings
 - a. See Ductile Iron Pipe
- 6. Ductile Iron Fittings Interior Lining
 - a. See Ductile Iron Pipe
- 7. Ductile Iron Fittings Polyethylene Encasement
 - a. See Polyethylene Encasement section within this specification

2.02 FLANGE INSULATING GASKET KITS

- A. Shall be installed at all locations between dissimilar pipe materials.
- B. Approved Manufacturer:
 - 1. Advance Products & Systems.
 - 2. Flange Protection & Gaskets, Inc.
 - 3. M&P Flange & Pipe Protection.
 - 4. Approved Equivalent.
- C. Size: Per diameter of flange.
- D. Pressure rating: Meet minimum pressure rating of attached piping.
- E. Provide to meet either full-faced or raised faced portion of flange.

1. Full-Faced Gasket
 - a. Type E gaskets.
 - b. Precision cut bolt holes.
 - c. Material: Plain face or Neoprene face phenolic.
 2. Raised Face Portion
 - a. Type F gaskets.
 - b. Inside diameter of the bolt hole circle should be slightly smaller than the outside diameter of the gasket, assuring an exact, automatic positioning of the gasket.
 - c. Material: Plain face or Neoprene face phenolic.
- F. Provide insulating sleeve and washer with the single insulation sets.
1. Material: High density polyethylene, phenolic, and Mylar.
 2. Provide with each set a 1/8" thick S.A.E. electro-plated steel washer.

2.03 POLYETHYLENE ENCASEMENT

- A. Conform to and install per ANSI/AWWA C105/A21.5.
- B. The polyethylene encasement shall consist of co-extruded layers of linear low-density polyethylene (LLDPE), which are fused into a single layer of not less than eight (8) mil thickness. Inside surface shall be infused with an antimicrobial biocide.
- C. Install on all underground metallic items, including: ductile iron pipe, ductile iron fittings, metal body valves, other metal pipe and fittings, fire hydrants, stainless steel couplings, transition couplings, and service and testing tapping saddles.
- D. Approved Manufacturers
 1. V-Bio Enhanced Polyethylene Encasement
 2. Approved Equivalent.

PART 3 EXECUTION

3.01 PREPARATION

- A. Make necessary field measurements to determine pipe laying lengths; fabricate pipe; deliver pipe to Site; store pipe with ends capped to prevent contamination and damage to interior; prepare pipe for installation; work pipe into place without forcing or springing.
- B. Do not store or ship small diameter pipe inside larger diameter pipe.
- C. Ream pipe and tube ends. Remove burrs. Repair lining at pipe cuts.
- D. Remove scale and dirt, inside and outside, before assembly.
- E. Remove welding slag or foreign material from pipe and fitting materials.

- F. Remove temporary preservative coatings from valves, fittings, and appurtenances prior to installation.
- G. Clean, repair, or replace equipment malfunctioning due to presence of foreign material left in piping during installation or entering piping after installation due to Contractor's work at no cost to Owner.
- H. All work performed and material furnished shall be inspected by the Contractor, but such inspection shall not relieve the manufacturer of responsibility to furnish material and perform work in accordance to this specification.

3.02 DUCTILE IRON PIPE AND FITTINGS

A. Joints:

- 1. Buried: Push-on or Mechanical.
- 2. Interior submerged: Flanged or grooved and shouldered.
- 3. Interior exposed: Flanged or grooved and shouldered, except where indicated otherwise on the Drawings.

B. Mechanical Joints:

- 1. Carefully assemble in accordance with the manufacturer's recommendation.
- 2. Bolts shall be uniformly tightened to the torque values listed in Appendix A of ANSI/AWWA C111/A21.11. Overtightening of bolts to compensate for poor installation practice will not be permitted.
- 3. The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods.

C. Flanged Joints:

- 1. Pipe shall extend completely through screwed-on flanges. The pipe end and flange face shall be finish machined in a single operation. Flange faces shall be flat and perpendicular to the pipe centerline.
- 2. Care shall be taken to avoid restraint on the opposite end of the pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress in the flanges when bolting flanged joints.
- 3. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be gradually tightened and at a uniform rate, to ensure uniform compression of the gasket.
- 4. Special care shall be taken when connecting piping to pumping equipment to ensure that piping stresses are not transmitted to the pump flanges. All connecting piping shall be permanently supported so that accurate matching of bolt holes and uniform contact over the entire

surface of the flanges is obtained before any bolts are installed in the flanges.

D. Grooved Joints:

1. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for Contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review Contractor is following best recommended practices in grooved product installation. (A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).)

E. Penetrations:

1. Install pipe straight through concrete walls or floors.
2. Provide wall sleeves where ductile iron pipe passes through concrete walls and floors, unless specified otherwise on Drawings.
3. Extend pipe such that the end extends 4" beyond the face of the wall unless specified otherwise on Drawings.
4. Install embedded wall flange in center of wall or floor and grout in place when embedded wall pipe flange shown on Drawings.
5. Fabricate wall pipes to dimensions required.

F. Support pipe at fittings with rods; anchor and support in accordance with Section 40 05 07 - Hangers and Supports for Process Piping.

G. Pipe and fittings to match face and drill of valves and appurtenances.

3.03 THREADED JOINTS

- A. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs.

3.04 DISSIMILAR PIPE CONNECTIONS

- A. Provide non-conducting connections or flange insulating gasket kits wherever jointing dissimilar metals in open systems.

3.05 POLYETHYLENE ENCASEMENT

- A. Where required all piping, fittings, valves, and appurtenances shall be fully encased in polyethylene film tubing.
- B. The polyethylene tubing shall be of appropriate size for the size of pipe being installed. Install polyethylene tubing prior to lowering pipe into trench.
- C. Tubing length shall be long enough to provide a minimum of one (1) foot overlap at all joints, fittings, and appurtenances. After completing the pipe jointing and positioning the tubing material, the overlap shall be secured into place with plastic adhesive tape wrapped circumferentially around the pipe at least three (3) full turns.
- D. The fit shall be snug over the pipe with no excess or bunched up material. Repair all rips, punctures, or other damage with taping and overlapping patching.

3.06 HYDROSTATIC PRESSURE TESTING

- A. Conduct pressure testing of the pipeline system in accordance with Section 33 13 10.

3.07 ALL JOINTS SHALL BE WATERTIGHT AND FREE FROM LEAKS. ALL LEAKS SHALL BE REPAIRED BY AND AT THE EXPENSE OF THE CONTRACTOR.

3.08 3.06 DISINFECTION OF POTABLE WATER SYSTEM

- A. Conduct disinfection of the pipeline system in accordance with Section 46 05 10.

END OF SECTION

SECTION 33 13 10
PIPELINE PRESSURE AND LEAKAGE TESTING

PART 1 **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Field hydrostatic pressure and leakage testing of water mains and associated appurtenances.

B. Related Sections included, but not limited to:

1. Section 01 33 00 – Submittal Procedures.
2. Section 01 45 00 – Quality Control.
3. Section 01 77 00 – Closeout Procedures.
4. Section 33 11 00 – Water Utility Distribution Piping.
5. Section 33 11 13 – Steel Water Transmission Pipe.
6. Section 46 05 10 – Disinfection of Water Systems.
7. American Public Works Association (APWA) Utah Chapter Manual of Standard Specifications, latest Edition, Section 33 08 00 - Commissioning of Water Utilities.

1.02 SUBMITTALS FOR INFORMATION

A. Section 01 33 00 – Submittal Procedures.

- B. Testing Schedule and Procedure - A testing schedule and test procedure shall be submitted to the Engineer for review and acceptance not less than 21 days prior to commencement of testing work. The schedule shall indicate the proposed time and sequence of testing of the pipeline. The testing procedure shall establish the limits of the pipeline to be tested, the position of all valves during testing, the location of temporary bulkheads, disposal of test water, and all other methods and procedures to be followed in performing the required testing work.

1.03 QUALITY ASSURANCE AND SPECIAL REQUIREMENTS

- A. All pipelines and appurtenances shall be pressure and leakage tested in accordance with AWWA C200 and these specifications.
- B. During testing of the water line, all valves shall be in the open position.
- C. Temporary bulkheads shall be provided during testing so that the test pressures are not applied to existing or new valves and hydrants, or to existing water lines or to any portion that has been put into service of new lines installed under this Contract.

- D. The tests shall be conducted before connections are made to existing water lines or to any portion that has been put into service or new water lines installed under this Contract.
- E. Upon completion of testing, connections made to existing water lines or to any portion that has been put into service of new water lines installed under this Contract shall be visually inspected for leakage after placing the water line into service and before backfilling the connection.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. All necessary piping connections between the line to be tested and the water source, together with pumping equipment, water meter, pressure gauges, backflow protection, and other equipment, materials, and facilities required to perform the specified tests, shall be provided. All flanges, valves, bulkheads, bracing, blocking, and other sectionalizing devices shall be provided. All temporary sectionalizing devices shall be removed upon completion of testing. Vents shall be provided in test bulkheads where necessary to expel air from the line to be tested.
- B. Test pressures to be applied by means of a force pump sized to provide and maintain the required pressure without interruption during the test.
- C. Water meters and pressure gauges shall be accurately calibrated and shall be subjected to review and acceptance by the Engineer.
- D. Permanent gauge connections shall be installed at each location where test gauges are connected to the pipeline in manholes during performance of required tests. Drilling and tapping of pipe walls will not be permitted. Upon completions of testing work, each gauge connection shall be fitted with a removable plug or cap acceptable to the Engineer.

PART 3 EXECUTION

3.01 PREPARATION

- A. When filling the line with water, care shall be taken to ensure that all air release valves, and other venting devices are properly installed in the open position. Hand-operated vent valves shall not be closed until water flows in an uninterrupted stream from each valve. Care shall be taken to ensure that the rate at which the line is filled with water does not exceed the venting capacity of the installed air vent valves and devices.

- B. Piping shall be adequately blocked, anchored, and supported before the test pressure is applied. Underground piping shall be tested before the joints are covered.

3.02 PRESSURE TESTING

- A. After the pipeline to be tested has been filled with water, the test pressure shall be applied and maintained without interruption for 2-hours plus the additional time required by the Engineer to examine all piping undergoing the test and for the Contractor to locate all defective joints and pipe materials.
- B. Measurements of leakage shall not be attempted until all trapped air has been vented and a constant test pressure has been established. After the pressure has stabilized, line leakage shall be measured by means of a suitable water meter installed in the pressure supply piping on the pipeline side of the force pump.
- C. Test the pipeline in sections.
- D. The test pressure, expressed in terms of feet of water, to be applied at any point in the line shall be equivalent difference between the specified test pressure plane elevation and the elevation of the horizontal center line of the line at the selected location. The value obtained shall be multiplied by 0.433 to obtain pounds per square inch.

3.03 LEAKAGE TESTING

- A. Following completion of pressure testing and acceptance by the engineer, the pipeline shall be subjected to a leakage test. The duration of the leakage test shall be 2-hours plus the additional time required by the Engineer for an accurate determination of the line leakage.
- B. The hydrostatic pressure maintained during leakage test shall be at least 90%, but no more than 100% of the pressure specified for pressure testing of the pipeline and shall be maintained within +/- 5% during the entire time that leakage measurements are being performed.
- C. Measurements of leakage shall not be attempted until all trapped air has been vented and a constant test pressure has been established. After the pressure has stabilized, line leakage shall be measured by means of a suitable water meter installed in the pressure supply piping on the pipeline side of the force pump.
- D. The term "leakage", as used herein, shall be the total amount of water, which must be introduced into the line during the leakage test to maintain the test pressure.
- E. No pipeline will be accepted if and while it exhibits a leakage rate in excess of that determined by the following formula:

$$Q = 10 DLT$$

Where:

Q = Allowable leakage in gallons per hour

D = Nominal diameter of pipe in inches

L = Length of section tested in miles

T = Time in days

- F. Whenever the pipeline to be tested contains pipe of different diameters, the allowable leakage shall be calculated separately for each diameter and corresponding length of line. The resulting allowable leakage rates shall be added to obtain the total allowable leakage for the entire pipeline.
- G. All joints in piping shall be watertight and free from visible leaks during the leakage test. Each leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of the Contractor regardless of any amount that the total line leakage rate, during the leakage test, may have been below the specified allowable leakage rate.
- H. If the leakage test indicates a line leakage rate exceeding the allowable, the Contractor shall locate and repair leaking joints and other defective items to the extent required to reduce the line leakage to an acceptable amount.

END OF SECTION

DIVISION 40 PROCESS INTERCONNECTIONS

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SECTION 40 05 06
COUPLINGS, ADAPTERS, AND SPECIALS FOR PROCESS PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:
 - a. Mechanical Couplings.
 - b. Flanged Coupling Adapters.
 - c. Restrained Flange Adapters.
 - d. Companion Flange.
 - e. Mechanical Joint Restraint Glands.
 - f. Dismantling Joints.
 - g. Expansion Joints.
 - h. Filler Flanges.

B. Related Sections include:

1. Section 00 73 40 – Funding Agency Requirements.
2. Section 01 33 00 – Submittal Procedures.
3. Section 01 45 00 – Quality Controls.
4. Section 01 61 00 – Common Product Requirements.
5. Section 01 75 00 – Starting and Adjusting.
6. Section 01 77 00 – Closeout Procedures.
7. Section 01 78 23 – Operations and Maintenance Data.
8. Section 01 79 00 – Demonstration and Testing.
9. Section 09 96 00 - High Performance Coatings
10. Section 40 05 24 - Steel Process Pipe
11. Section 40 05 58 - Process Valves

1.02 SUBMITTALS

- A. Shop Drawings and Product Data shall be submitted in accordance with specification Section 01 33 00.
- B. Operations and Maintenance Data shall be submitted in accordance with specification Section 01 78 23.

1.03 QUALITY ASSURANCE

- A. The equipment and material to be furnished under this Contract shall be in accordance with Section 01 45 00 Quality Controls and Section 01 61 00 Common Product Requirements.

1.04 REGULATORY REQUIREMENTS

- A. All Products that come into contact with water intended for use in a Public Water System shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

1.05 WARRANTY REQUIREMENTS

- A. A written warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period identified herein and shall begin from the date of Final Completion, as defined in Section 01 77 00. Such warranty shall cover all defects or failures of materials or workmanship that occur as the result of normal operation and service. No prorated warranty will be accepted.
 - 1. Contractor's Warranty: One (1) Year.
 - 2. Manufacturer's Warranty: Minimum of one (1) year but not less than manufacturer's standard warranty period.

PART 2 PRODUCTS

2.01 SPECIALTIES CONNECTIONS

- A. Provide pipe specialties suitable to connect to adjoining pipes as specified for pipe fittings. Diameter to match adjacent and adjoining piping.

2.02 WORKING PRESSURE

- A. Working pressure of pipe specialties to be equal to working pressure of connecting pipes, unless specified otherwise.

2.03 MECHANICAL COUPLINGS

- A. A space of at least ¼-inch, but not more than 1-inch, shall be left between the pipe ends.
- B. Pipe and coupling surfaces in contact with gaskets shall be clean and free of dirt and other foreign matter during assembly.
- C. All assembly bolts shall be gradually tightened and at a uniform rate, so that the coupling is free from leaks and all parts of the coupling are square and symmetrical with the pipe.

- D. The interior surfaces of the middle rings shall be prepared for coating in accordance with the instructions of the coating manufacturer and shall then be coated with liquid epoxy in accordance with ANSI/AWWA C210. The remaining components shall be cleaned and shop primed with universal primer.
- E. Repair and damaged areas of shop coatings on the pipe and coupling to the satisfaction of the Engineer.
- F. Provide steel tie-bolts, diametrically opposite, which extend across the joint from lugs welded to the pipe on either side of the joint to provide restraint.

2.04 FLANGED COUPLING ADAPTERS

- A. After the pipe is in place and bolted tight, the proper locations of holes for anchor studs or lock pins shall be determined and the pipe shall be field-drilled.
- B. The inner surfaces of the couplings shall be prepared for coating in accordance with the instructions of the coating manufacturer and shall then be coated with liquid epoxy in accordance with ANSI/AWWA C210. The remaining surfaces, except the flange mating surfaces, shall be cleaned and shop primed with universal primer.

2.05 RESTRAINED FLANGE ADAPTERS

- A. Ductile Iron conforming to ASTM A536.
- B. Shall have a minimum working pressure equal to adjacent pipe.
- C. Shall be provided with manufacturer applied epoxy coating.
- D. Shall include torque limiting screws to insure proper initial set of gripping wedges.
- E. Type and Manufacturer:
 - 1. Series 2100 MegaFlange by EBAA Iron, Inc.
 - 2. Series 7200 Super Flange by Star Pipe Products.
 - 3. Approved Equivalent.

2.06 COMPANION FLANGE

- A. Ductile Iron conforming to ASTM A536 on ductile iron piping or steel conforming to ASTM A53 for use on steel piping.
- B. NPT threads.
- C. Flanges: ANSI Class 125 per ASME B16.1 and ANSI/AWWA C111/A21.11. Bolt holes shall straddle the center line.

2.07 MECHANICAL JOINT RESTRAINT GLAND

- A. Ductile Iron conforming to ASTM A536.
- B. Shall have a minimum working pressure equal to adjacent pipe.
- C. Shall be provided with manufacturer applied epoxy coating.
- D. Shall include torque limiting screws to insure proper initial set of gripping wedges.
- E. Type and Manufacturer:
 - 1. Series 1100 Megalug by EBAA Iron, Inc.
 - 2. Series 3000 Super Flange by Star Pipe Products.
 - 3. Approved Equivalent.

2.08 DISMANTLING JOINTS

- A. End Ring and Body Material:
 - 1. 12-inches and smaller: ASTM A536 Ductile Iron
 - 2. 14-inches and larger: ASTM A 36 Steel
- B. Connection: AWWA Class D steel ring flange, compatible with ANSI Class 150 drill pattern.
- C. Shall be provided with high tensile steel tie rods.
- D. Assembly tolerances:
 - 1. 12-inches and smaller: 2-inches
 - 2. 14-inches and larger: 3-inches
- E. Approved Manufacturer:
 - 1. Romac DJ400.
 - 2. Approved Equivalent

2.09 EXPANSION JOINTS

- A. High Pressure Stainless Steel Expansion Joints
 - 1. Designed to protect critical mechanical equipment and reduce noise created by vibration and fluid pulsation
 - 2. Shall be provided with stainless steel control rods
 - 3. Size: As indicated on the Drawings.
 - 4. Minimum Pressure Rating: 350 psig
 - 5. Maximum Temperature: 70 °F.
 - 6. Flange: ANSI 300 pound

7. Location: Discharge pipe of high service pumps
8. Schedule:
 - a. Axial Compression: 0.25-inches
 - b. Lateral: 1.25-inches
9. Approved Manufacturers
 - a. U.S. Bellows, Inc.
 - b. Mercer Rubber
 - c. Approved Equivalent

B. Rubber Expansion Joints

1. Connection: ANSI 150 Class Drill Pattern with split back-up rings.
 - a. Split back-up rings shall be coated or galvanized steel.
2. 24-inch Diameter Design:
 - a. Neutral Length: 10 to 14-inches
 - b. Minimum Axial Compression: 2.0-inches
 - c. Minimum Axial Extension: 1.0-inches
 - d. Minimum Lateral Deflection: 0.9-inches
 - e. Minimum Angular Deflection: 4.8 degrees
 - f. Minimum pressure rating: 100 psig
 - g. Maximum Operating Temperature: 250°F
 - h. Single Wide Arch, un-filled
 - i. Tube and Cover Material: EPDM
 - j. Limit / Control Rods: stainless steel
3. Approved Manufacturers
 - a. Mercer Rubber Co.
 - b. Proco Products, Inc. Style 231
 - c. Twin City Hose, Inc.
 - d. Approved Equivalent.

2.10 FILLER FLANGES

- A. Ductile iron conforming to the requirements of AWWA C115, maximum 250 psi working pressure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment in locations shown on the Drawings.

3.02 MECHANICAL JOINT RESTRAINT GLAND

- A. Install per AWWA C600 and manufacturer's recommended installation procedures.

3.03 DISMANTLING JOINTS

- A. Pipe supports shall be provided on each side of joint within 12-inches. Pipe supports shall be in accordance with specification Section 40 05 07.

3.04 EXPANSION JOINTS

- A. Pipe supports shall be provided on each side of joint within 12-inches. In the event the joint is mounted to a tank or pump one pipe support shall be required on end opposite of equipment. Pipe supports shall be in accordance with specification Section 40 05 07 - Hangers and Supports for Process Piping.

END OF SECTION

SECTION 40 05 07
HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:

1. Pipe Hanger Supports.
2. Floor Pipe Supports.
3. Anchors.

B. Related Sections include:

1. Section 00 73 40 – Funding Requirements.
2. Section 01 33 00 – Submittal Procedures.
3. Section 01 45 00 – Quality Controls.
4. Section 01 61 00 – Common Product Requirements.
5. Section 01 75 00 – Starting and Adjusting.
6. Section 01 77 00 – Closeout Procedures.
7. Section 01 78 23 – Operations and Maintenance Data.
8. Section 01 79 00 – Demonstration and Testing.
9. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping
10. Section 40 05 24 - Steel Process Pipe
11. Section 40 05 58 - Process Valves

1.02 REFERENCES

A. Reference Standards include:

1. ANSI B 31.10: Pipe Supports.
2. ASTM A36: Structural Steel.
3. ASTM A325: High Strength Bolts for Structural Steel Joints.

1.03 SUBMITTALS

A. Shop Drawings and Product Data shall be submitted in accordance with specification Section 01 33 00.

1. Submittal shall include detailed plan and sections illustrating the layout of only the pipe system. Drawings shall include referenced details that specify all sizes and hardware for all components of support. Include maximum loading of detailed support.

1.04 QUALITY ASSURANCE

- A. The equipment and material to be furnished under this Contract shall be in accordance with Section 01 45 00 Quality Controls and Section 01 61 00 Common Product Requirements.

1.05 WARRANTY REQUIREMENTS

- A. A written warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period identified herein and shall begin from the date of Final Completion, as defined in Section 01 77 00. Such warranty shall cover all defects or failures of materials or workmanship that occur as the result of normal operation and service. No prorated warranty will be accepted.
 - 1. Contractor's Warranty: One (1) Year.
 - 2. Manufacturer's Warranty: Minimum of one (1) year but not less than manufacturer's standard warranty period.

PART 2 PRODUCTS

2.01 GENERAL

- A. In certain locations anchors, expansion joints, and pipe supports have been indicated on the Drawings, but no attempt has been made to indicate every restraint, anchor, and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping in accordance with the requirements set forth herein.
- B. Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper pipe or tubing shall be copper plated. Portions of pipe supports which come into contact with other metals that are dissimilar shall be rubber or vinyl coated.
- C. All other materials shall be as described within their individual sections.

2.02 DESIGN RESPONSIBILITY

- A. When specific concrete and fabricated steel supports are shown, Contractor shall provide and install said supports as indicated on the Drawings. Any deviation from pipe shown supports within the Drawings shall only be allowed with the written consent of the Engineer of Record.
- B. When pipe supports are not shown it shall be the responsibility of the Contractor to design, size, and layout pipe supports as specified herein and in accordance with the standard details provided in the Drawings.
- C. Minimum requirements for support system are provided in Article 3.02 herein.

- D. Design shall be provided by a Registered Professional Engineer who is a full time employee of the pipe support supplier.
- E. Typical pipe supports shown on the Drawings may or may not be located in a manner that allows for direct bracing to a structural member that has sufficient capacity to resist the pipe support loads. The Contractor shall be responsible for adjusting and coordinating the location of supports with the Engineer. The Contractor shall be responsible for providing additional structural framing or modifications to specified structural framing.
- F. Piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures.

2.03 PIPE HANGER SUPPORTS

- A. Pipe hangers for pipe greater than or equal to 12-inches nominal diameter shall utilize concrete inserts to support piping from new cast-in-place. If embedded channels are utilized channel shall not interfere with rebar cover.
- B. Expansion anchors may be used for hangers supporting pipe less than 12-inches nominal diameter. Anchors shall be of the undercut design. Epoxy anchors shall not be allowed.
- C. Minimum vertical adjustment: 1.5-inches.
- D. Design hangers to support piping without disconnection of pipe.
- E. Materials
 - 1. Unless otherwise specified, all pipe supports shall comply with ANSI/MSS SP-58 and MSS SP-69. Materials of construction for fabricated steel supports are covered in the structural and miscellaneous metals section. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.
 - 2. Material finish shall be hot-dipped galvanized finish.
 - 3. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.
 - 4. Pipe supports shall be manufactured for the sizes and types of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item.
 - 5. The use of supports that rely on stressed thermoplastic components to support the pipe will not be acceptable.
 - 6. Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Supports for brass or copper

pipe or tubing shall be copper plated. Portions of pipe supports which come into contact with other metals that are dissimilar shall be rubber or vinyl coated.

7. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead-ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops, or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints.

F. Manufacturer and Type, or equivalent:

1. Light welded steel bracket: Anvil Figure 194.
2. Concrete Inserts:
 - a. Unistrut P3760 Series Insert.
 - b. Anvil Figure 152.
 - c. Anvil Figure 282.
3. Undercut Anchors:
 - a. Maxi-Bolt by Drillco Group.
 - b. HDA Anchors by Hili.
4. Adhesive Anchors:
 - a. Hilti HIT-HY 200.
5. Offset Pipe Clamp: Figure 103.
6. Adjustable Clevis Hanger: Anvil Figure 260
7. Pipe Rollers and Supports: MSS SP 58 and MSS SP 69, Type 44.

2.04 FLOOR PIPE SUPPORTS

A. Adjustable pipe saddle supports

1. Approved Manufacturer and Type:
 - a. ASC Engineered Solutions, adjustable pipe saddle support: Figure 264.
 - b. Standon Model S92 Saddle Support.
 - c. PHD Manufacturing Inc., adjustable pipe saddle support: Figure 876.
 - d. Approved Equivalent.
2. Minimum vertical adjustment: 4.5 inches.
3. Provide in hot dipped galvanized finish.
4. Provide complete with riser pipe and flange bolts for floor mounting.
5. Provide grout base a minimum of 1" above floor.
6. Provide as per recommended spacing, at minimum. Contractor shall install a minimum of one floor pipe support per pump discharge piping prior to the header piping.

7. Contractor may also be required to construct concrete saddle pipe supports for floor piping as indicated on the Drawings. Contractor to provide all materials, formwork, and labor to construct as detailed on Drawings.

2.05 WALL PIPE AND SLEEVES

- A. All pipe penetrations through water bearing and exterior walls shall contain an integral water stop, or collar, located at the center of the wall. The water stop shall extend a minimum 3-inches past the outer diameter of the wall pipe.
- B. Stainless steel wall pipe shall extend past the face of the wall and incorporated flanged end connections compatible with adjacent pipe. Stainless steel wall pipe with flanges cast flush with the wall shall not be acceptable. Refer to Drawings for Details.
- C. Ductile iron wall pipe shall be mechanical style with ends cast flush with wall faces. Refer to Drawings for Details.
- D. PVC wall pipes or sleeves shall be not allowed.
- E. Size sleeves large enough to allow for installation of annular seal.
- F. Sleeves shall be carbon steel material with bituminous coating where sleeve will be in contact with concrete. Exposed areas of sleeve shall be coated with epoxy coating.

2.06 ANCHORS

- A. Hollow Concrete Block and Brick Anchors:
 1. Acceptable Manufacturer and Type:
 - a. HIT S 12/A Combi Fastener manufactured by Hilti Corporation.
 - b. Approved Equivalent.
 2. Accessories: HY20 Adhesive with screen tube insert.
- B. Use Type 316 stainless steel epoxy adhesive anchor bolts, injection adhesive anchors, or equal, for building or structure attachments. Provide continuous concrete inserts, Unistrut P3200 series, or equal, where applicable.
- C. Mechanical anchor and powder-actuated drive-pin fasteners shall be used only with prior approval from the Engineer.

2.07 FABRICATION

- A. Size sleeves large enough to allow for installation of annular seal.
- B. Design hangers to support piping without disconnection of pipe.

2.08 FINISH

- A. As specified throughout this section.

PART 3 EXECUTION

3.01 INSERTS

- A. Provide and install inserts for placement in concrete formwork.
- B. Provide and install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams and walls.
- C. Where concrete slabs form finished ceiling, provide inserts to be flush with slab surface.
- D. Ensure adequate rebar cover is maintained as required in Section 03 30 00 and Section 03 20 00.

3.02 PIPE HANGERS AND SUPPORTS

- A. Support horizontal piping as follows:

Pipe Size	Max Hanger/ Support Spacing	Min Hanger/ Support Rod Diameter
1/2 to 1-1/4 inch	6'-6"	3/8"
1-1/2 to 2 inch	10'-0"	3/8"
2-1/2 to 3 inch	10'-0"	1/2"
4 to 6 inch	10'-0"	5/8"
8 to 12 inch	10'-0"	7/8"
14 to 18 inch	10'-0"	1"
20 to 30 inch	10'-0"	1-1/2"
PVC/CPVC (all sizes)	5'-0"	1/2"

- B. Install supports free standing or suspended to provide minimum 1/2 inch space between support and adjacent Work.
- C. Place a hanger/support within 12 inches of each horizontal fitting, on each side of valves, on each side of rubber expansion joints, on each side of dismantling joints, and within 12 inches of any wall pipe connection.
- D. Support riser piping independently of connected horizontal piping.

3.03 SLEEVES

- A. Set sleeves in position in formwork. Provide reinforcing around sleeves per details on structural drawings.

- B. Extend sleeves through floor above finished floor level.
- C. Where piping penetrates floor, ceiling, or wall, close off space between pipe and sleeve with link seal.

3.04 THRUST ANCHORS AND GUIDES

- A. For suspended piping, center thrust anchors as closely as possible between expansion joints and between elbows and expansion joints. Anchors shall hold pipe securely and shall be sufficiently rigid to force expansion and contraction movement to take place at expansion joints and/or elbows and to preclude separation of joints.
- B. Provide thrust anchors as required to resist thrust due to changes in diameter or direction or dead end of pipelines. The design of all anchors shall be subject to approval by Engineer. Anchorage shall be required wherever bending stresses exceed allowable for pipe. Wall pipes may be used as thrust anchors.
- C. Pipe guides shall be provided adjacent to sliding expansion joints in accordance with the recommendations of the National Association of Expansion Joint Manufacturers.

3.05 INSERTS AND ANCHORS

- A. Furnish and install inserts or anchors for placement in concrete.
- B. Furnish and install inserts or anchors for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams and walls.
- C. Utilize support assemblies designed for the appropriate loads. Contractor shall verify design conditions of each piping system.
- D. Mechanical anchor and powder-actuated drive-pin fasteners shall be installed in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Non-adhesive anchors shall be only used with prior approval from the Engineer.

3.06 PAINTING

- A. Prime coat non-galvanized steel hangers and supports.
- B. Finish coat all hangers and supports under provisions of Specification Section 09 96 00.

END OF SECTION

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SECTION 40 05 23
STAINLESS STEEL PROCESS PIPE AND TUBING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:
2. Pipe, fittings, wall pipes, connections, and gauges associated with:
 - a. Stainless Steel Pipe and Fittings.

B. Related section include:

1. Section 00 73 40 – Funding Agency Requirements.
2. Section 01 33 00 – Submittal Procedures.
3. Section 01 45 00 – Quality Controls.
4. Section 01 61 00 – Common Product Requirements.
5. Section 01 70 00 – Starting and Adjusting.
6. Section 01 77 00 – Closeout Procedures.
7. Section 01 78 23 – Operations and Maintenance Data.
8. Section 01 79 00 – Classroom and Demonstration Training.
9. Section 09 96 00 - High Performance Coatings
10. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping
11. Section 40 05 07 - Hangers and Supports for Process Piping
12. Section 40 05 58 - Process Valves
13. Section 40 05 97 - Identification for Process Equipment

1.02 QUALITY ASSURANCE

- A. The equipment and material to be furnished under this Contract shall be in accordance with Section 01 45 00 Quality Controls and Section 01 61 00 Common Product Requirements.
- B. Welding Materials and Procedures: Conform to ANSI/AWS D.1.1.
- C. Employ certified welders.
- D. Piping modifications subject to Engineer's review. No additional compensation allowed for modifications required to suit equipment furnished by Contractor.

1.03 REFERENCES

- A. Reference Standards include:

1. ANSI/AWWA C200: Steel Water Pipe, 6 In. (150 mm) and Larger.
2. ANSI/AWWA C206: Field Welding of Steel Pipe.
3. ANSI/AWWA C207: Steel Pipe Flanges for Waterworks Service, Sizes 4 In. through 144 In. (100 mm Through 3,600 mm).
4. ANSI/AWWA C208: Dimensions for Fabricated Steel Water Pipe Fittings.
5. ANSI/AWWA C219: Bolted, Sleeve-Type Couplings for Plain-End Pipe.
6. AWWA C600-10: Installation of Ductile-Iron Water Mains and Their Appurtenances.
7. AWWA C606-11: Grooved and Shouldered Joints.
8. AWWA C651-05: Standard for Disinfecting Water Mains.
9. AWWA C653-03: Disinfection of Water Treatment Plants.
10. NSF Standards No. 60 and 61: National Sanitation Foundation.
11. AWS D.1.: Structural Welding Code – Steel.

1.04 SUBMITTALS

- A. Submit Shop Drawings in accordance with Section 01 33 00 for all pipe and fittings indicating: Name of Manufacturer, Materials, Standard Dimensions, References, and Joint Data.
- B. Piping coordination drawings are to be supplied by the pipe manufacture or the fitting manufacture only for all piping 2-1/2" and larger. These drawings are to be submitted to the engineer and are to indicate elevations, center lines, equipment locations, pipe lengths, fittings, valves and appurtenances via a bill of material.

1.05 PAINTING AND IDENTIFICATION SYSTEMS

- A. Provide process pipe identification per Section 40 05 97 - Identification for Process Equipment.
- B. Contractor shall refinish and restore all equipment that has sustained damage to the manufacturer's finish or prime coats of paint or enamel to their original appearance.
- C. Finish painting of all materials and equipment in this section shall be the responsibility of the Contractor and shall be as described in Section 09 96 00 - High Performance Coatings, unless otherwise specifically indicated.

1.06 REGULATORY REQUIREMENTS

- A. All Products that may come into contact with water intended for use in a Public Water System shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

1.07 WARRANTY REQUIREMENTS

- A. A written warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period identified herein and shall begin from the date of Final Completion, as defined in Section 01 77 00. Such warranty shall cover all defects or failures of materials or workmanship that occur as the result of normal operation and service. No prorated warranty will be accepted.
 - 1. Contractor's Warranty: One (1) Year.
 - 2. Manufacturer's Warranty: Minimum of one (1) year but not less than manufacturer's standard warranty period.

PART 2 PRODUCTS

2.01 STAINLESS STEEL PIPE AND FITTINGS

- A. Material
 - 1. ASTM A312 stainless steel pipe, Schedule 10 or 40, Type 304 or 316 with stainless steel drilled flanges, rated for 175 psi minimum. Refer to Pipe Schedule.
 - a. On-site inspection by Contractor of all materials.
 - b. Bolts and nuts: Stainless steel.
 - c. Flanges shall be double welded.
 - d. Pipe and fittings to match face and drill of valves.
 - e. All materials to be new and unused.
 - f. Mechanical couplings: Dresser Style 38, Victaulic Style 230, Style 232 (formerly Depend-O-Lok ExE, FxF), or approved equivalent.
 - 2. Contractor shall use the extra low carbon version of stainless steel if piping is identified as 304L, 316L, or in any form of this (i.e., 3xxL).
- B. Pickling and Passivation
 - 1. Following shop fabrication of pipe sections, straight spools, fittings, and other piping components, pickle and passivate fabricated pieces.
 - 2. Immerse fabricated pieces in sulfuric acid solution followed by immersion in a nitric-hydrofluoric bath and subsequent wash at the proper temperature and length of time.
 - 3. Finish Requirements: Remove free iron, heat tint oxides, weld scale, and other impurities, and obtain a passive finished surface.
- C. Welded or Flanged Pipe
 - 1. Stainless steel ASTM A312, welded process Grade TP316L, unless otherwise specified hereafter. Schedule 10S or Schedule 40S as noted or shown. Stainless steel drilled flanges, or slip on flanges, rated for 175 psi minimum.

2. Contractor shall use the extra low carbon version of stainless steel if piping is identified as 304L, 316L, or in any form of this (i.e., 3xxL).
3. Flanges shall be flat faced for water service and shall be raised for air or gas service except when connecting to flat face equipment or valve flanges.
4. Flange Bolts: ASTM A193 Class 2, AISI Tpe 304, ANSI B18.2.1, heavy hex head, length such that after installation, the bolts will project 1/8 to 3/8 inch [3 to 10 mm] beyond outer face of the nut.
5. Flange Nuts: ASTM A194, AISI Type 304, ANSI/ASME B18.2.2, heavy hex pattern. Washers shall be installed under the nuts.

D. Branch Connections

1. Branch connections 2-1/2 inches and smaller shall be made with welding fittings. Welded outlets shall be used. Where the exact outlet size desired is in doubt, but is known to be less than 1 inch. A 1-inch outlet shall be provided and reducing bushings used as needed.
2. Branch connections sized 3 inches and larger shall be made with pipe nipples or with welding fittings with welded outlets. Pipe nipples and welding fittings shall be welded to the pipe shell and reinforced as needed to meet design and testing requirements. The pressure rating of branch and branch connections shall equal or exceed the pressure rating of the main pipe it is connected to.
3. Small branch connections shall be so located that they will not interfere with joints, supports, or other details, and shall be provided with caps or plugs to protect the threads during shipping and handling.

E. Buttwelded, Beveled Ends

1. Piping designated as Buttwelded, Beveled Ends shall be per the size, schedule, and material indicated on the drawings and Pipe Schedule.
2. Pipe shall be ASTM A312 Grade TP316L, unless otherwise indicated in the piping schedule.
3. Fittings shall be buttwelded ASTM A403 WP316L conforming to ANSI/ASME B16.9.

F. Fittings

1. Type 316L stainless steel conforming to ASTM A403, manufactured in accordance with ASTM A778.
2. Wall thickness of fitting: In accordance with ANSI B36.19 for the schedule of pipe specified.
3. Dimensional Standards:
 - a. Fittings with weld ends: In accordance with ANSI B16.9.
 - b. Fittings with flanged ends: In accordance with ANSI B16.5

- G. For pipe sizes 2" and smaller, the Victaulic Vic-Press (Pressfit) 304 piping system may be used in lieu of threaded or welded fittings. The system shall be rated for 300 psig CWP and suitable for operating temperatures to +230 degrees F with EPDM O-ring seals. Victaulic Vic-Press piping systems are to be supplied with Schedule 5 Victaulic Vic-Press 304 pipe only. Vic-Press 304 piping may be used in lieu of threaded or welded joints.
- H. Gasket Material: Flexitalic "Style CG", spiral wound. Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

PART 3 EXECUTION

3.01 SHOP FABRICATION

- A. Piping design indicated on Drawings illustrates piping layout and configuration and does not indicate the location of every field joint and coupling that may be needed to connect piping sections fabricated in the shop.
- B. All welds shall have 100 percent penetration. The internal weld bead shall be small, smooth, and continuous with no crevices, pits, or other voids. The external weld bead shall be well rounded, smooth, and continuous with no anomalies.
- C. All welded connections shall be parallel and perpendicular to the extent that the piping appears to be correct to the naked eye or bubble level.
- D. Pipe edges shall be prepared by machine cutting or shaping using an aluminum oxide blade. Beveled ends shall conform to the requirements of ANSI B16.9.
- E. Clean weld joints and weld joint areas both before and after welding in accordance with ASTM A380 using stainless steel wire brushes or stainless steel wool.
- F. Align ends to be joined within commercial tolerances on diameter, wall thickness, and out-of-roundness.

3.02 PREPARATION

- A. Make necessary field measurements to determine pipe laying lengths; fabricate pipe; deliver pipe to Site; store pipe with ends capped to prevent contamination and damage to interior; prepare pipe for installation; work pipe into place without forcing or springing.
- B. Do not store or ship small diameter pipe inside larger diameter pipe.
- C. Ream pipe and tube ends. Remove burrs. Repair lining at pipe cuts.
- D. Remove scale and dirt, inside and outside, before assembly.

- E. Remove welding slag or foreign material from pipe and fitting materials.
- F. Remove temporary preservative coatings from valves, fittings, and appurtenances prior to installation.
- G. Clean, repair, or replace equipment malfunctioning due to presence of foreign material left in piping during installation or entering piping after installation due to Contractor's work at no cost to Owner.
- H. All work performed and material furnished shall be inspected by the Contractor, but such inspection shall not relieve the manufacturer of responsibility to furnish material and perform work in accordance to this specification.

3.03 THREADED JOINTS

- A. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs.
- B. Threaded joints in plastic piping shall be made with Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer, or a suitable joint compound. Thread tape and joint compound or sealers shall not be used in threaded joints that are to be seal welded.

3.04 DISSIMILAR PIPE CONNECTIONS

- A. Provide non-conducting connections or flange insulating gasket kits wherever jointing dissimilar metals in open systems.

3.05 TESTING

- A. Hydrostatically test each entire line in accordance with AWWA C600.
- B. Refer to the Piping Schedule for the minimum test pressure requirements.
- C. All joints shall be watertight and free from leaks. All leaks shall be repaired by and at the expense of the Contractor.

3.06 DISINFECTION

- A. Disinfect process and miscellaneous water piping accordance with AWWA C651 and AWWA C653.

END OF SECTION

SECTION 40 05 24
STEEL PROCESS PIPE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:
 - a. Steel Pipe and Fittings
 - b. Spiral Welded Steel Water Pipe - 6-inch Diameter and Larger
 - c. Flange Insulating Gasket Kits

B. Related section include:

1. Section 00 73 40 – Funding Agency requirements.
2. Section 01 33 00 – Submittal Procedures.
3. Section 01 45 00 – Quality Controls.
4. Section 01 61 00 – Common Product Requirements.
5. Section 01 70 00 – Starting and Adjusting.
6. Section 01 77 00 – Closeout Procedures.
7. Section 01 78 23 – Operations and Maintenance Data.
8. Section 01 79 00 – Classroom and Demonstration Training.
9. Section 09 96 00 - High Performance Coatings
10. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping
11. Section 40 05 07 - Hangers and Supports for Process Piping
12. Section 40 05 58 - Process Valves
13. Section 40 05 97 - Identification for Process Equipment

1.02 REFERENCES

A. Reference Standards include:

1. ANSI/AWWA C200: Steel Water Pipe, 6 In. (150 mm) and Larger.
2. AWWA C205-24: Cement–Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop Applied.
3. ANSI/AWWA C206-23: Field Welding of Steel Pipe.
4. ANSI/AWWA C207-23: Steel Pipe Flanges for Waterworks Service, Sizes 4 In. through 144 In. (100 mm Through 3,600 mm).
5. ANSI/AWWA C208-22: Dimensions for Fabricated Steel Water Pipe Fittings.
6. AWWA C210-24: Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings.

7. ANSI/AWWA C219-23: Bolted, Sleeve-Type Couplings for Plain-End Pipe.
8. AWWA C602-23: Cement–Mortar Lining of Water Pipelines in Place — 4 In. (100 mm) and Larger.
9. AWWA C606-11: Grooved and Shouldered Joints.
10. AWWA C651-05: Standard for Disinfecting Water Mains.
11. AWWA C653-03: Disinfection of Water Treatment Plants.
12. NSF Standards No. 60 and 61: National Sanitation Foundation.
13. AWS D.1.: Structural Welding Code – Steel.

1.03 SUBMITTALS

- A. Submit Shop Drawings in accordance with Section 01 33 00 for all pipe and fittings indicating: Name of Manufacturer, Materials, Standard Dimensions, References, and Joint Data.
- B. Piping coordination drawings are to be supplied by the pipe manufacture or the fitting manufacture only for all piping 2-1/2" and larger. These drawings are to be submitted to Engineer and are to indicate elevations, center lines, equipment locations, pipe lengths, welds, fittings, valves and appurtenances via a bill of material.
- C. Submit design calculations for structural design of pipe thickness following AWWA Manual M11 Steel Pipe Design and Installation Guide where pipe class or thickness is not specifically called out.
- D. Grooved/shouldered joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified with the applicable style or series designation.
- E. Submit written certification from the grooved/shouldered component manufacture that all grooved/shouldered components (couplings, fittings, valves, gaskets, bolts and nuts) are of the same manufacture and grooving tools are of the same manufacturer as the grooved/shouldered components.
- F. Operations and Maintenance Data shall be submitted in accordance with specification Section 01 78 23.

1.04 QUALITY ASSURANCE

- A. The equipment and material to be furnished under this Contract shall be in accordance with Section 01 45 00 Quality Controls and Section 01 61 00 Common Product Requirements.
- B. Welding Materials and Procedures: Conform to ANSI/AWS D.1.1.

1. Employ certified welders for field welding.
- C. Piping modifications subject to Engineer's review. No additional compensation allowed for modifications required to suit equipment furnished by Contractor.

1.05 PAINTING AND IDENTIFICATION SYSTEMS

- A. Finish painting of all materials and equipment in this Section shall be the responsibility of the Contractor, and shall be as described in Section 09 96 00, unless otherwise specifically indicated.
- B. Provide process pipe identification per Section 40 05 97 - Identification for Process Equipment.

1.06 REGULATORY REQUIREMENTS

- A. All Products that may come into contact with water intended for use in a Public Water System shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

1.07 WARRANTY REQUIREMENTS

- A. A written warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period identified herein and shall begin from the date of Final Completion, as defined in Section 01 77 00. Such warranty shall cover all defects or failures of materials or workmanship that occur as the result of normal operation and service. No prorated warranty will be accepted.
 1. Contractor's Warranty: One (1) Year.
 2. Manufacturer's Warranty: Minimum of one (1) year but not less than manufacturer's standard warranty period.

PART 2 PRODUCTS

2.01 STEEL PIPE AND FITTINGS

- A. Steel Pipe, NPS 2 inch (DN 50) and smaller: ASTM A53, Type S (seamless) or Type F (furnace-butt welded), Grade A, Schedule 40, Black Steel, plain ends.
- B. Steel Pipe, NPS 2-1/2 inch through NPS 12 inch (DN 65 through DN 300): ASTM A53, Type E (electric-resistance welded), Grade A, Schedule 40, black steel, plain ends, Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced.

C. Spiral Weld Steel Pipe Fittings

1. Pipe material used in the fittings shall be of the same material and minimum thickness as the pipe. Fittings shall be equal in pressure design strength and shall have lining and coating as specified in Spiral Weld Steel Water Pipe.
2. All fittings shall have the wall thickness increased so that the combined stresses due to internal pressure (circumferential and longitudinal) and bending will not exceed 67 percent of the yield strength of the pipe material.
3. Wall thicknesses of the reducing sections shall not be less than the required thicknesses for the larger ends.
4. Whether or not indicated on the Drawings, additional wall thickness shall be provided as required to ensure that the combined stresses do not exceed the specified maximum. Unless otherwise indicated or directed, the internal pressure shall be the specified field test pressure for the piping adjacent to the time in question.
5. Special fittings shall be plant fabricated from ASTM A139 Grade C steel with a minimum yield strength of 42,000 psi. Flanges and blind flanges shall be Class E conforming to AWWA C207.
6. Fittings shall conform to the dimensions of AWWA C208 or may be fabricated into standard or special pipe lengths. Elbows up to 22 ½ degrees shall be two piece; over 22 ½ degrees through 45 degrees shall be three pieces; over 45 degrees through 67 ½ degrees shall be four pieces; and over 67 ½ degrees through 90 degrees shall be five pieces. Elbows shall have a minimum radius of 2 ½ times the pipe O.D. All tees, laterals and outlets shall be reinforced in accordance with AWWA M11.

D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

E. Grooved: May be used in lieu of threaded or welded joints.

1. Pipe shall be Schedule 40 ASTM A53 carbon steel. The pipe shall be a maximum 20' lengths and be supplied with rolled groove end for groove end couplings.
2. Fittings for grooved end steel pipe 2-in and larger shall be wrought steel ASTM A234, or factory-fabricated steel ASTM A53. Fittings shall be galvanized or enamel coated, with grooved joints.
3. Grooved joint couplings shall consist of two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Constructed of ductile iron housings conforming to ASTM A-395 Grade 65- 45-15 and ASTM A-536 Grade 65-45-12.

- a. Rigid Type: Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.
 - 1) 2-in thru 8-in: Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 107 Quick-Vic.
 - 2) 10-in thru 12-in: Victaulic Style 07 Zero-Flex.
 - 3) 14-in thru 60-in: Housing key shall fill the wedge shaped AGS groove and provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style W07 AGS.
 - b. Flexible Type: For use in locations where vibration attenuation and stress relief are required. Three flexible couplings may be used in lieu of a flexible connector. Victaulic Style 75, 77 or 107.
 - 1) 2-in thru 8-in: Installation-Ready, for direct stab installation without field disassembly. Victaulic Style 177 Quick-Vic.
 - 2) 10-in thru 12-in: Victaulic Style 77 Zero-Flex.
 - 3) 14-in thru 60-in: Housing key shall fill the wedge shaped AGS groove and provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9. Victaulic Style W77 AGS.
 - c. Groove flanges for connection to 2" – 24" ANSI Class 125/150 flange components only shall be Victaulic style 741 or W741 groove flanges.
 - d. Groove coupling and groove flange adapter gaskets are to be rated by the coupling manufacture of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. Gaskets are to be of elastomer material with properties as designated in ASTM D-2000.
- F. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- G. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.

2.02 SPIRAL WELDED STEEL WATER PIPE - 6-INCH DIAMETER AND LARGER:

- A. Working and test pressures are provided on the drawings. Steel pipe shall be designed per AWWA Manual M11 standards.
- B. Electrically butt-welded straight-seam or spiral-seam pipe and seamless pipe.

- C. Grades of pipe shall be:
1. Type E (electric-resistance welded) or S (seamless) for ASTM A53.
 2. A36, A283, A570, A572 for ASTM A134.
 3. All grades for ASTM A135.
 4. All grades for ASTM A139.
- D. Thickness and Weight: The wall thickness and weight tolerances for welded pipe shall be governed by the requirements of the specifications to which the plates or sheets are ordered.
- E. Circumference: The pipe shall be substantially round. The outside circumference of the pipe shall not vary more than ± 1 percent, but not to exceed $\frac{3}{4}$ -inch from the nominal outside circumference based on the nominal diameter.
- F. Straightness: Finished pipe shall not deviate by more than $\frac{1}{8}$ -inch from a 10-foot long straightedge held against the pipe.
- G. Lengths: Specified pipe lengths shall be furnished with a tolerance of ± 2 inches.
- H. Preparation of Ends: If pipe is specified to have the ends beveled for field butt welding, the ends shall be beveled to an angle of 30° with a tolerance of $+5^\circ$, -0° with a root face of $\frac{1}{16}$ -inch $\pm \frac{1}{32}$ -inch.
- I. Ends Fitted with Flanges: Ends to be fitted with flanges shall be grinded (longitudinal and spiral welds), at ground flush for a sufficient distance to allow proper installation of the flange.
- J. Ovality (Out-of-Roundness): The out-of-roundness of pipe ends shall be consistent with the diameter and wall thickness.
- K. Diameter: The tolerance on the diameter at the ends is of $-\frac{1}{16}$ -inch and $+\frac{1}{8}$ -inch of the specified diameter.
- L. Squareness of Ends: For pipe that is to be butt-welded in the field, the ends of pipe sections shall not vary by more than $\frac{1}{8}$ -inch at any point from a true plane perpendicular to the axis of the pipe and passing through the center of the pipe at the end.
- M. Special Ends: The ends of the pipes shall be supplied with joint configurations and tolerances other than those described above if agreed upon between manufacturer and Engineer. In such cases, pipe ends shall conform to the description of the detail drawings provided by the Engineer.
- N. Flanges:

1. Flanges shall be in accordance with ANSI/AWWA C207 Class D for operating/transient pressures to 175 psi and test pressures to 218 psi on 4 inch through 12 inch diameter, and operating/transient pressures to 150 psi and test pressures to 187 psi on diameters over 12 inches.
2. Flanges shall be in accordance with ANSI/AWWA C207 Class E for operating/transient pressures from 150 psi to 275 psi and test pressures to 343 psi.
3. Shop lining shall be continuous to the end of the pipe. Shop coating shall be continuous to the back of the attached flange. Flange faces shall be shop coated with a soluble rust preventive compound.
4. Steel plate, bar, and forgings used in the manufacturing of flanges shall meet the following requirements:
 - a. Specified minimum tensile strength: 50,000 psi
 - b. Specified minimum yield strength: 32,000 psi
 - c. Elongation:
 - 1) 2-inch gage length (min): 18 percent
 - 2) 8-inch gage length (min): 14 percent
 - d. Carbon (max): 0.29 percent
 - e. Phosphorous (max): 0.04 percent
 - f. Sulfur (max): 0.05 percent

O. Groove and shoulder connections:

1. Grooved and shoulder (or split sleeve) couplings are shown throughout the drawings to provide means for disassembly of piping to remove components such as the flow meter, reduce the size of welded steel piping assemblies, and provide for installation flexibility.
2. Split sleeve couplings shall be restrained joint on both connections and meet AWWA C227.
3. Grooved and shoulder couplings shall be Victaulic style 232 or approved equal and provided in pressure ratings meeting or exceeding the pipe pressure rating.
 - a. Body, shoulders, closure plates: carbon steel ASTM A36
 - b. Sealing plate: Stainless Steel 316L
 - c. O-ring gaskets: EPDM
 - d. Restraint rings: carbon steel ASTM A108
 - e. Stud, hex nuts, washers: stainless steel.
 - f. Coatings: fusion bonded epoxy meeting AWWA C213

P. Bolts, Nuts, and Gaskets:

1. Bolts and studs shall be ASTM A193 Grade B7 with ASTM A194 Grade 2H heavy hex nuts, ASTM A563 heavy hex nuts for 1 inch and smaller.

2. Gaskets shall be of the type, thickness, and material shown in Table 1 of ANSI/AWWA C207 for the Class of flange, working pressure limit, and diameter listed. Provide flange insulating gasket kits where required per Section 40 05 06.

Q. Fittings:

1. Unless otherwise shown on the drawing, all specials and fittings shall meet the minimum dimensional requirements of ANSI/AWWA C208 except that the ends of the fittings may be longer.
2. Material used in the fittings shall be of an equivalent material and the same minimum pipe thickness as the pipe.
3. The minimum radius of elbows shall be 2.5 times the pipe outside diameter and the maximum miter angle on each section of the elbow shall not exceed $11\frac{1}{4}^{\circ}$. If an elbow radius is less than 2.5 times the pipe diameter, stresses shall be checked per AWWA M11 and wall thickness or yield strength increased if necessary.
4. Fittings shall be equal in pressure design strength and shall have a lining and coating as specified.
5. Fabricate specials and fittings from hydrostatically tested pipe, wherever practical.

R. Coating and Linings (unless otherwise specifically noted on the Drawings):

1. Pipe shall be coated with epoxy type coating in accordance with C210-15. The pipe shall receive a field finish coating per Section 09 96 00 - High Performance Coatings prior to installation of pipe insulation.
2. Pipe shall be cement mortar lined in the shop by the centrifugal process in accordance with AWWA C205. Cement mortar lined pipe shall be braced as required to maintain roundness during shipping and handling and shall have ends capped prior to shipment. Pipe end caps shall remain in-place during storage until the pipe is ready for installation. For pipe 14-inch nominal diameter and larger, the finished ID after lining shall be the nominal size. For pipe 12-inch nominal diameter and smaller, standard OD pipe sizes shall be furnished.
3. Linings and coatings at field welds, if applicable, shall follow pipe supplier's standards for field installation.

2.03 FLANGE INSULATING GASKET KITS

A. Flange insulating kits shall provide complete galvanic separation between pipe materials and be provided at all of the following junctions:

1. between steel pipe and ductile iron pipe
2. between stainless steel pipe and steel pipe

3. between steel pipe and ductile iron valves
 4. between steel pipe and flow meters
- B. Approved Manufacturer:
1. Advance Products & Systems.
 2. Flange Protection & Gaskets, Inc.
 3. M&P Flange & Pipe Protection.
 4. Approved Equivalent.
- C. Size: Per diameter of flange.
- D. Pressure rating: Meet minimum pressure rating of attached piping.
- E. Provide to meet either full-faced or raised faced portion of flange.
1. Full-Faced Gasket:
 - a. Type E gaskets.
 - b. Precision cut bolt holes.
 - c. Material: Plain face or Neoprene face phenolic.
 2. Raised Face Portion:
 - a. Type F gaskets.
 - b. Inside diameter of the bolt hole circle should be slightly smaller than the outside diameter of the gasket, assuring an exact, automatic positioning of the gasket.
 - c. Material: Plain face or Neoprene face phenolic.
- F. Provide insulating sleeve and washer with the single insulation sets.
1. Material: High density polyethylene, phenolic, and Mylar.
 2. Provide with each set a 1/8" thick S.A.E. electro-plated steel washer.

PART 3 EXECUTION

3.01 SHOP FABRICATION

- A. Piping design indicated on Drawings illustrates piping layout and configuration and does not indicate the location of every field joint and coupling that may be needed to connect piping sections fabricated in the shop.
- B. All welds shall have 100 percent penetration. The internal weld bead shall be small, smooth, and continuous with no crevices, pits, or other voids. The external weld bead shall be well rounded, smooth, and continuous with no anomalies.
- C. All welded connections shall be parallel and perpendicular to the extent that the piping appears to be correct to the naked eye or bubble level.

- D. Pipe edges shall be prepared by machine cutting or shaping using an aluminum oxide blade. Beveled ends shall conform to the requirements of ANSI B16.9.
- E. Clean weld joints and weld joint areas both before and after welding in accordance with ASTM A380 using stainless steel wire brushes or stainless steel wool.
- F. Align ends to be joined within commercial tolerances on diameter, wall thickness, and out-of-roundness.

3.02 PREPARATION

- A. Make necessary field measurements to determine pipe laying lengths; fabricate pipe; deliver pipe to Site; store pipe with ends capped to prevent contamination and damage to interior; prepare pipe for installation; work pipe into place without forcing or springing.
- B. Do not store or ship small diameter pipe inside larger diameter pipe.
- C. Ream pipe and tube ends. Remove burrs. Repair lining at pipe cuts.
- D. Remove scale and dirt, inside and outside, before assembly.
- E. Remove welding slag or foreign material from pipe and fitting materials.
- F. Remove temporary preservative coatings from valves, fittings, and appurtenances prior to installation.
- G. Clean, repair, or replace equipment malfunctioning due to presence of foreign material left in piping during installation or entering piping after installation due to Contractor's work at no cost to Owner.
- H. All work performed and material furnished shall be inspected by the Contractor, but such inspection shall not relieve the manufacturer of responsibility to furnish material and perform work in accordance to this specification.

3.03 STEEL PIPE

- A. The manufacturer shall maintain a quality-assurance program to ensure that minimum standards are met. A certified welding inspector shall be used to verify that welders and welding procedures are qualified, procedures are being followed with limitation of testing, and quality-assurance functions are being implemented.
- B. The finished pipe shall be free from unacceptable defects. Defects in seamless pipe or in the parent metal of welded pipe will be considered unacceptable when the depth of the defect is greater than 12.5 percent of the nominal wall thickness.

- C. The repair of defects will not be permitted if the depth of the defect exceeds $\frac{1}{3}$ the nominal wall thickness of the pipe and if the length of that portion of the defect in which the depth exceeds 12.5 percent is greater than 25 percent of the outside diameter of the pipe. Each length of repaired pipe shall be tested hydrostatically in accordance with standard requirements.
- D. Welding:
 - 1. Lap joints, butt joints, and butt-strap joints shall be in accordance with the latest revision of ANSI/AWWA C206.
 - 2. A full-time welding inspector shall be present whenever there is a welding to be performed. Weld inspector shall have prior pipe-welding inspection experience.
 - 3. Visual inspection of the field welds shall be in accordance with Section 5.1.4 of the ANSI/AWWA C206. Any of the weld defects identified by visual inspection shall be cause for rejection, and the deficient weld shall be repaired or replaced.
- E. Flanges shall be attached to the pipe, fittings, or other appurtenances by two fillet welds of the size shown in Figure 1 of ANSI/AWWA C207.
- F. Mechanical Couplings:
 - 1. Mechanical couplings shall be sleeve type couplings, and shall conform to ANSI/AWWA C219.
 - 2. Where tie joints are required, mechanical couplings shall be harnessed for the maximum test pressure (test pressure or transient pressure) in accordance with AWWA M11.
 - 3. Pipe ends for mechanical couplings shall conform to ANSI/AWWA C200 and ANSI/AWWA C219. Harness lugs or rings and pipe ends shall be coated with epoxy conforming to ANSI/AWWA C210. The inside linings shall be continuous to the end of the pipe.

3.04 THREADED JOINTS

- A. Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be fully and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed after threading and before assembly to remove all burrs.
- B. Threaded joints in plastic piping shall be made with Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer, or a suitable joint compound. Thread tape and joint compound or sealers shall not be used in threaded joints that are to be seal welded.

3.05 DISSIMILAR PIPE CONNECTIONS

- A. Provide non-conducting connections or flange insulating gasket kits wherever jointing dissimilar metals in open systems.

3.06 TESTING

- A. Hydrostatically test each entire line in accordance with AWWA C200.
- B. Refer to the schedule in drawings for the minimum test pressure requirements.
- C. All joints shall be watertight and free from leaks. All leaks shall be repaired by and at the expense of the Contractor.

3.07 DISINFECTION

- A. Disinfect process and miscellaneous water piping accordance with AWWA C651 and AWWA C653.

END OF SECTION

SECTION 40 05 57
ACTUATORS FOR PROCESS VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:
 - a. Manual Actuators.
 - b. Standard Electric Actuators.

B. Related Sections include:

1. Section 00 73 40 – Funding Agency requirements.
2. Section 01 33 00 – Submittal Procedures.
3. Section 01 45 00 – Quality Controls.
4. Section 01 61 00 – Common Product Requirements.
5. Section 01 75 00 – Starting and Adjusting.
6. Section 01 77 00 – Closeout Procedures.
7. Section 01 78 23 – Operations and Maintenance Data.
8. Section 01 79 00 – Demonstration and Testing.
9. Section 09 96 00 - High Performance Coatings
10. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping
11. Section 40 05 07 - Hangers and Supports for Process Piping
12. Section 33 11 14 - Ductile Iron Pipe and Fittings
13. Section 40 05 23 - Stainless Steel Process Pipe and Tubing
14. Section 40 05 31 - Polyvinyl Chloride Process Pipe
15. Section 40 05 58 - Process Valves

C. Reference Standards:

1. Except as modified or supplemented herein, vane type actuators shall conform to applicable requirements of ANSI/AWWA C541.
2. Except as modified or supplemented herein, actuators for butterfly and eccentric plug valves shall conform to the applicable requirements of ANSI/AWWA C504.
3. Except as modified or supplemented herein, manual actuators for ball valves shall conform to the applicable requirements of ANSI/AWWA C507.

1.02 SUBMITTALS

- A. Shop Drawings and Product Data shall be submitted in accordance with specification Section 01 33 00 and shall include detailed specifications, drawings, and data covering all materials, parts, devices, equipment, and other accessories forming part of equipment for the complete operational system.
- B. Operations and Maintenance Data shall be submitted in accordance with specification Section 01 78 23.

1.03 QUALITY ASSURANCE

- A. The equipment and material to be furnished under this Contract shall be in accordance with Section 01 45 00 Quality Controls and Section 01 61 00 Common Product Requirements.

1.04 WARRANTY REQUIREMENTS

- A. A written warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period identified herein and shall begin from the date of Final Completion, as defined in Section 01 77 00. Such warranty shall cover all defects or failures of materials or workmanship that occur as the result of normal operation and service. No prorated warranty will be accepted.
 - 1. Contractor's Warranty: One (1) Year.
 - 2. Manufacturer's Warranty: Minimum of one (1) year but not less than manufacturer's standard warranty period.

PART 2 PRODUCTS

2.01 MANUAL ACTUATORS

- A. Approved Manufacturers:
 - 1. Dezurik.
 - 2. Pratt.
 - 3. Valmatic.
 - 4. Approved Equivalent.
- B. Manual actuators of the types listed in the valve specifications or schedules shall be provided by the valve manufacturer. Actuators shall produce the required torque with a maximum pull of 80 lbs on the lever, handwheel, or chain and shall withstand, without damage, a pull of 200 lbs on the handwheel or chainwheel or an input of 300 foot-lbs on the operating nut.
- C. Types:

1. Handwheel Actuator: Handwheel diameters shall be at least 8 inches but not more than 24 inches for 30 inch and smaller valves and not more than 30 inches for 36 inch and larger valves.
 2. Chainwheel Actuator: Unless otherwise specified in the valve schedules, all valves with center lines more than 7'-0" above the floor shall be provided with chainwheels and operating chains. Each chainwheel operated valve shall be equipped with a chain guide which will permit rapid handling of the operating chain without "gagging" of the wheel and will also permit reasonable side pull on the chain. Suitable extensions shall be provided, if necessary, to prevent interference of the chain with adjacent piping or equipment. Operating chains shall be hot-dip galvanized or zinc plated carbon steel and shall be looped to extend within 4 feet of the floor below the valve.
 3. Levers Actuator: Levers shall be capable of being locked in at least five intermediate positions between fully open and fully closed. In any building or structure containing lever operated valves, at least two operating levers shall be provided for each size and type of lever operated valve.
- D. Provide manual gear/handwheel actuator on all valves unless indicated otherwise on the Drawings. The direction of rotation of the wheel, wrench nut, or lever to open the valve shall be to the left (counterclockwise). Each valve body shall have cast thereon the word "OPEN" and an arrow indicating the direction to open.
- E. The housing of traveling-nut type actuators shall be fitted with a removable cover which shall permit inspection and maintenance of the operating mechanism without removing the actuator from the valve. Travel limiting devices shall be provided inside the actuator for the open and closed positions. Travel limiting stop nuts or collars installed on the reach rod of traveling-nut type operating mechanisms shall be field adjustable and shall be locked in position by means of a removable roll pin, cotter pin, or other positive locking device. The use of stop nuts or adjustable shaft collars which rely on clamping force or setscrews to prevent rotation of the nut or collar on the reach rod will not be acceptable.
- F. Each actuator shall be designed so that shaft seal leakage cannot enter the actuator housing.
- G. Valves for throttling service shall be equipped with an infinitely variable locking device or a totally enclosed gear actuator.
- H. Provide riser stem and floor mounted base as indicated on the Drawings.
- I. Provide position indicator.

2.02 STANDARD ELECTRIC ACTUATORS

- A. Approved Manufacturers:
 - 1. Rotork Actuation, IQ Series with IW gears
 - 2. Limitorque MX Series.
 - 3. Auma
 - 4. Approved Equivalent.
- B. Motor actuators are to be powered from a single point 480V, 3 phase source.
- C. Complete with motor, gearing, integral reversing starters, local control facilities, local position indicator, NEMA 6 enclosure, and a separately sealed terminal compartment with terminals for remote control and indication connections.
- D. Provide externally adjustable mechanical stops to prevent over travel.
- E. Designed to automatically actuate butterfly valve requiring one quarter turn between fully opened and fully closed positions.
- F. Designed for modulated position operation.
- G. Designed with torque limiting feature that prevents valve or actuator damage, if any obstruction interferes with normal valve rotation, in either direction.
- H. Provide padlockable manual override to enable the valve to be manually operated. The override shall have clutch to disengage the motor before manual operator can be engaged. Motor operation shall automatically disengage manual drive.
- I. Equip with limit switches to indicate open and closed positions.
- J. The actuator shall have an internal 24 VDC power supply for remote control functions. The internal supplies shall be protected against overcurrent and short circuit faults. Terminals shall be included to connect the electronic controls package.
- K. Valve position shall be displayed on the actuator enclosure as a percent of open, 0-100 percent.
- L. Motors for open/close service shall be capable of 60 cycles per hour without overload or damage. Motors for modulating service shall be capable of at least 1200 cycles per hour without overloading or damage.
- M. Provide with automatic phase correction, single phase protection, instant motor reversal protection, torque switch hammer protection, and voltage spike protection.

- N. Furnish and Install manufactured base plate for each actuator.
- O. Controller:
 - 1. Each valve shall be furnished with a circuit breaker disconnect and a reversing controller located either inside the actuator housing or mounted on the housing in a NEMA Type 4 enclosure. The controller shall be equipped with:
 - a. A motor overload protective device in each phase, and a normally open overload contact.
 - b. A terminal block with connectors for all external controls. All leads from the actuator motor and limit switch assembly shall be routed to terminal connections in the controller for external connections to all other control devices.
 - 2. Reversing controllers shall be both mechanically and electrically interlocked and provided with the necessary direct-operated auxiliary contacts for required interlocking and control.
 - 3. "Open-Stop-Close" push buttons or switch and a "Local-Off-Remote" selector switch and red and green indicating lights shall be furnished as a part of the enclosure.
 - 4. Valve controllers shall be expressly selected for long life and reliable, maintenance-free service under rugged service conditions.
- P. Control Performance:
 - 1. For any operating torque within the specified range of the valve actuator, the valve and actuator shall perform within these specified limits:
 - a. Linearity: Linearity of actual valve position as compared to demand signal shall be within plus or minus 4.0 percent of span over the entire operating range.
 - b. Repeatability: For any repeated demand signal to the valve actuator, the actual valve position shall be repeated within 0.5 percent of span.
 - c. Deadband: Deadband of the valve actuator shall be adjustable from 1.0 to 10 percent of span.
 - d. Hysteresis: For any repeated demand signal to the valve actuator, from either an increasing or a decreasing direction, the actual valve position shall be repeated within 1 degree of valve shaft rotation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install actuator on valve per manufacturer's recommendations.
- B. Install actuators in the locations shown on Drawings. Verify configuration with Owner and Engineer.

- C. Provide adequate structural support of installed actuators and valves as required.
- D. Valve tags to be installed so as not to interfere with valve or actuator operation.

3.02 PAINTING

- A. All material and equipment in this Section shall be factory finished. Primer shall be compatible with finish coats of paint provided under Section 09 96 00.
- B. The Contractor shall refinish and restore to the original appearance all equipment that has sustained damage to the manufacturer's finish or prime coats of paint or enamel.
- C. Finish painting of all materials and equipment in this Section that are not concealed or factory finished shall be the responsibility of the Contractor and shall be as described in Section 09 96 00. Paint per specifications, unless otherwise specifically indicated.

END OF SECTION

SECTION 40 05 58
PROCESS VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installation of the following, in accordance with the provisions of the Contract Documents.
 - a. AWWA Butterfly Valves.
 - b. Double Offset Butterfly Valves
 - c. Wafer / Lug Butterfly Valves.
 - d. Globe Check Valves.
 - e. Ball Valves.
 - f. Air and Vacuum Release Valves.
 - g. Air Release Valves.
 - h. Pressure Relief Valves.

B. Related Sections Include:

1. Section 01 33 00 – Submittal Procedures.
2. Section 01 45 00 – Quality Controls.
3. Section 01 61 00 – Common Product Requirements.
4. Section 01 70 00 – Starting and Adjusting.
5. Section 01 77 00 – Closeout Procedures.
6. Section 01 78 23 – Operations and Maintenance Data.
7. Section 01 79 00 – Classroom and Demonstration Training.
8. Section 09 96 00 - High Performance Coatings
9. Section 40 05 06 - Couplings, Adapters, and Specials for Process Piping
10. Section 40 05 07 - Hangers and Supports for Process Piping
11. Section 33 11 14 - Ductile Iron Pipe and Fittings
12. Section 40 05 23 - Stainless Steel Process Pipe and Tubing
13. Section 40 05 97 - Identification for Process Equipment

C. Reference Standards Include:

1. AWWA C504: Rubber-Seated Butterfly Valves.
2. ANSI/AWWA C507: Ball Valves, 6 In. Through 60 In.
3. AWWA C509: Resilient-Seated Gate Valves for Waterworks Services, 2 inches through 24 inches NPS.
4. AWWA C512: Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
5. AWWA C515: Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.

6. ANSI/AWWA C541: Hydraulic and Pneumatic Cylinder and Vane- Type Actuators for Valves and Slide Gates.
7. ANSI/AWWA C542: Electric Motor Actuators for Valves and Slide Gates.
8. AWWA C550: Protective Epoxy Interior Coatings for Valves and Hydrants.
9. ANSI/AWWA C561: Fabricated Stainless Steel Slide Gates.
10. ANSI/AWWA C563: Fabricated Composite Slide Gates.
11. ASTM D-1784: Rigid Polyvinyl Chloride Compounds and Chlorinated Polyvinyl Chloride Compounds.
12. ASTM-D2464: Threaded Polyvinyl Chloride Plastic Pipe Fittings, Schedule 80.
13. ASTM F437: Threaded Chlorinated Polyvinyl Chloride Plastic Pipe Fittings, Schedule 80.
14. ASTM A351 CF8M: Standard Specification for Castings, Austenitic, for Pressure-Containing Parts
15. ANSI B16.5: American National Standard Pipe Flanges and Flanged Fittings.
17. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc. Standard Practice 67.

1.02 SUBMITTALS

- A. Shop Drawings and Product Data shall be submitted in accordance with specification Section 01 33 00 and shall include detailed specifications, drawings, and data covering all materials, parts, devices, equipment, and other accessories forming part of equipment for the complete operational system.
- B. Operations and Maintenance Data shall be submitted in accordance with specification Section 01 78 23.

1.03 QUALITY ASSURANCE

- A. The equipment and material to be furnished under this Contract shall be in accordance with Section 01 45 00 Quality Controls and Section 01 61 00 Common Product Requirements.

1.04 REGULATORY REQUIREMENTS

- A. All Products that may come into contact with water intended for use in a Public Water System shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60, 61 and 372, as appropriate.

- B. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

1.05 WARRANTY REQUIREMENTS

- A. A written warranty shall be provided for the equipment specified in this Section. The warranty shall be for a minimum period identified herein and shall begin from the date of Final Completion, as defined in Section 01 77 00. Such warranty shall cover all defects or failures of materials or workmanship that occur as the result of normal operation and service. No prorated warranty will be accepted.
 - 1. Contractor's Warranty: One (1) Year.
 - 2. Manufacturer's Warranty: Minimum of one (1) year but not less than manufacturer's standard warranty period.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
- B. The tag number designated by the Engineer, as indicated in the Process Schedules, shall be stamped on a corrosion-resistant plate attached to both the actuator and valve.
- C. Unless otherwise indicated, use valves suitable for 150 psi minimum working pressure. Valves off the high service pipeline should be suitable to 200 psi minimum working pressure.
- D. Valve Operators, as shown on Drawings or as specified.
- E. Valve materials shall be compatible with the liquid or chemical service for that particular valve and consistent with piping materials. Contractor shall submit valve service to Owner and Engineer for confirmation of chemical compatibility.
- F. A valve schedule is provided on the Drawings for Contractor's convenience and the Engineer does not warrant the accuracy of valve types, operators, locations, connections, or other requirements. Contractor shall verify all valve sizes and requirements with the Drawings and Specifications and notify Engineer of any discrepancies.

2.02 VALVE CONNECTIONS

- A. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use full port size valves, unless otherwise specified.

- B. Threaded connections for pipe sizes 1-1/2 inches and smaller unless indicated otherwise.
- C. Flanged connections for pipe sizes 2 inches and larger unless indicated otherwise.
- D. PVC/CPVC pipe to be glued true union unless indicated otherwise.
- E. Metallic valves in chemical services shall have socket weld ends or flanges as indicated in the Drawings.
- F. Valves connected to tanks in chemical services shall be flanged.

2.03 AWWA BUTTERFLY VALVES

- A. Butterfly valves for process piping:
 - 1. Approved Manufacturers:
 - a. Dezurik.
 - b. Pratt.
 - c. Valmatic
 - d. Approved Equivalent.
- B. Design:
 - 1. Standard: Meets AWWA C504.
 - 2. Type of body: Flanged short body.
 - 3. Valve classification: 150B.
 - 4. Shaft Seal: Self-adjusting Chevron type.
 - 5. Body and Disc Material: Ductile iron.
 - 6. Seat Material: EPDM; simultaneously bonded and vulcanized to the valve body.
 - 7. Valve Shaft: AISI Type 304 or 316 Stainless Steel.
 - 8. End Connections: Flanged ends.
 - 9. Position Indicators as specified herein.

2.04 DOUBLE OFFSET BUTTERFLY VALVES

- A. Butterfly valves for process piping:
 - 1. Approved Manufacturer:
 - a. Av-Tek DEX Double Eccentric Butterfly Valve.
 - b. VAG EKN Double Eccentric Butterfly Valve
 - c. Approved Equivalent.
- B. Design:
 - a. Standard: Meets AWWA C504.

- b. Type of body: Flanged short body.
- c. End Connections: Flanged ends.
- d. Valve Drill Pattern: ANSI B16.1 Class 125.
- e. Required Working Pressure: 250 psi minimum.
- f. Body and Disc Material: Ductile iron.
- g. Seat Material: EPDM on disc fastened with stainless steel fasteners
- h. Seating Surface on Body: Stainless steel seating surface
- i. Valve Shaft: Stainless Steel.
- j. Shaft Seals: use multiple O-Rings, EPDM material
- k. Shaft Bearings: Thrust bearings shall be lead free bronze meeting NSF approvals.
- l. Finish: NSF certified fusion bonded epoxy, on internal and external areas, with minimum 14 mils DFT. Coating system shall be factory holiday tested.
- m. Position Indicators as specified herein.

2.05 WAFER / LUG BUTTERFLY VALVES

A. Butterfly valves for wafer / lug applications:

- 1. Approved Manufacturers:
 - a. Dezurik.
 - b. Av-Tek.
 - c. Approved Equivalent.

B. Wafer and Lug - Design:

- 1. Standard: ASTM A351.
- 2. Type of body / End Connection: Wafer and Lug
- 3. Valve Classification: ANSI Class 150. Valve classification as necessary to match pipeline pressure requirements.
- 4. Single offset disc design.
- 5. Body Material: Ductile Iron in one-piece.
- 6. Disc Material: ductile iron or aluminum bronze.
- 7. Seat Material: EPDM.
- 8. Valve Shaft: one-piece or two-piece 316 or 410 Stainless Steel.
- 9. Shaft Bearings: aluminum bronze
- 10. Coatings: NSF approved epoxy or fusion bonded epoxy, 10 mill DFT minimum thickness.
- 11. Minimum pressure rating: 250 psi
 - a. Provide factory testing to 110% of minimum pressure rating.
- 12. All wafer / lug style valves will be fitted with electric actuators per the valve schedule on the drawings.

2.06 GLOBE CHECK VALVES

A. Globe Check Valves, silent-type design:

1. Approved Manufacturer and type:
 - a. Series 600 Silent Check Valve manufactured by Dezurik
 - b. Series 581 manufactured by Cla-Val.
 - c. SDX Sliding Disc by Av-Tek
 - d. Approved Equivalent.
- B. Design:
1. Body: cast iron, ASTM A126 Class B or ductile iron ASTM A536 65-45-12.
 2. Elastomeric Seat: provide with resilient seat with EPDM seal material mounted on valve disc with 316 stainless steel seat retainer. Seat shall be field replaceable and adjustable with common tools.
 3. Metallic Seat: metallic body seat shall be 316L NiCr stainless steel
 4. Disc / Plug: Ductile Iron ASTM A536 65-45-12 or 304 stainless steel
 5. Shaft: Made of high strength grade 316 stainless steel.
 6. Spring: stainless steel, ASTM A276 Type 316.
 7. Bushing: Bronze, ASTM B62 or 304 Stainless Steel.
 8. Guides: Two (2) at opposite ends of disk shaft.
 9. Coatings: fusion bonded epoxy minimum 12 mil DFT.
 10. Minimum pressure rating: 250 psi
 11. Flow area through body: Equal to or greater than area of equivalent size pipe.

2.07 BALL VALVES

- A. Full-port ball valves up to 4-inch size:
1. Approved Manufacturers and Type:
 - a. Apollo 70LF Series Ball Valve.
 - b. Approved Equivalent.
 2. Design:
 - a. Body: Bronze.
 - b. Ball and stem: Stainless steel.
 - c. Cold Working Pressure: 600 psig
- B. V-port ball valves:
1. Approved Manufacturers and Type:
 - a. Bray Flow-Tek Advanced V-Control ball valve.
 - b. Valtorc Series VP-1000.
 - c. Approved Equivalent.
 2. Design:
 - a. Body: Stainless steel.
 - b. Ball: 316 stainless steel.
 - c. Seats: Reinforced PTFE.
 - d. Seals: Compatible with fluid or chemical.

C. Operation

1. Quarter turn shut off.
2. Provide accessories (including compression fittings, NPT adaptors, etc.) to ensure complete operating system. All accessories shall be corrosion resistant to the chemical application.

2.08 AIR AND VACUUM RELEASE VALVES

A. Approved Manufacturers and Type:

1. APCO Model 1904.
2. Val-Matic Series 100.
3. Av-Tek
4. Approved Equivalent.

B. Material:

1. Body and Cover: Cast iron, ASTM A126.
2. Float: Stainless steel, ASTM A240.
3. Seat: Buna-N or other suitable material to seal with low water pressure.
4. Linkage: Stainless steel.
5. Needle: Stainless steel.
6. Other Internal Parts: Stainless steel.
7. Finish: fusion bonded epoxy on interior and exterior

C. Spare Parts: Provide one (1) spare cover gasket for each different size and type of air and vacuum release valve.

D. Function: Release large quantities of air from the system and allow air to re-enter the system upon loss in pressure. Air/Vacuum valves shall be fully automatic float operated valves designed to exhaust large quantities of air during the pipe filling of piping systems and close upon liquid entry. The valve shall re-open during draining or if a negative pressure occurs.

E. Flanged discharge of the valve shall be piped to discharge towards the drain. A minimum 2-inch air gap, at least 18 inches above the floor, should be provided between the discharge piping from the air valve and the piping directed towards the drain.

F. Standards, Approvals and Verification

1. Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512.
2. Valves used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components - Health Effects.

G. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

H. Connections

1. Valve sizes 3 in. and smaller shall have full size NPT inlets and outlets equal to the nominal valve size. The body inlet connection shall be hexagonal for a wrench connection.
2. Valve sizes 4 in. and larger shall have bolted flange inlets with threaded or plain outlets and protective hoods to prevent debris from entering the valve. Flanges shall be in accordance with ANSI B16.1 for Class 125 or Class 250 iron flanges and ANSI B16.5 for Class 150 or Class 300 steel flanges.
3. The valve shall have two additional NPT connections for the addition of Air Release Valves, gauges, testing, and draining.

I. Design

1. The valve body shall provide a through flow area equal to the nominal valve size. A bolted cover with alloy screws and flat gasket shall be provided to allow for maintenance and repair.
2. Floats shall be unconditionally guaranteed against failure including pressure surges. The float shall have a hexagonal guide shaft supported in the body by circular bushings to prevent binding from debris. The float shall be protected against direct water impact by an internal baffle.
3. The resilient seat shall provide drop tight shut off to the full valve pressure rating. The seat shall be a minimum of 0.5 in. thick on 2 in. and larger valves and secured in such a manner as to prevent distortion. Valves with working pressures above 400 psig shall have metal seats with synthetic seals.
4. On valve sizes 4 in. and larger, the cover shall be fitted to the valve body by means of a machined register to maintain concentricity between the top and bottom guide bushings at all times. The float shall be double guided with a guide shaft extending through the float to prevent any contact with the body. A resilient bumper shall be provided to cushion the float during sudden opening conditions.

J. Manufacturer

1. The manufacturer shall demonstrate a minimum of five (5) years of experience in the manufacture of air valves. When requested, the manufacturer shall provide test certificates, dimensional drawings, parts list drawings, and operation and maintenance manuals.
2. The exterior of the valve shall be coated with a universal alkyd primer.

2.09 AIR RELEASE VALVES

A. General Service:

1. Approved Manufacturer and Type:
 - a. APCO.
 - b. Val-Matic.
 - c. Av-Tek.
 - d. Approved Equivalent.
2. Material:
 - a. Standard: AWWA C512.
 - b. Inlet Size: Refer to schedule in Paragraph 2.12A.9.
 - c. Body and Cover: Refer to schedule in Paragraph 2.12A.9.
 - d. Float: Stainless steel, ASTM A240.
 - e. Seat: Stainless steel or Buna-N.
 - f. Linkage: Stainless steel.
 - g. Needle: Stainless steel.
 - h. Other Internal Parts: Stainless steel.
3. Function: Release accumulations of air in the pipeline to maximize pipeline efficiency.
4. Standards, Approvals, and Verification:
 - a. Valves shall be manufactured and tested in accordance with American Water Works Association (AWWA) Standard C512.
 - b. Valves used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components - Health Effects
5. Pressure Rating:
 - a. Refer to schedule in Paragraph 2.12.A.9.
6. Connections
 - a. Threaded discharge of the valve shall be piped to discharge towards the nearest drain. A minimum 2-inch air gap, at least 18 inches above the floor, should be provided between the discharge piping from the air valve and the piping directed towards the drain.
7. Spare Parts: Provide two (2) spare cover gaskets for each different size.
8. Model Number: Model listed in Paragraph 2.12A.9 are APCO model numbers. Approved Equivalent suppliers shall provide equivalent model numbers to those listed.

2.10 PRESSURE RELIEF VALVES

A. Process Pipe Pressure Relief Valve:

1. Valve Operation: Valve shall automatically relieve inlet pressure by quickly opening once pressure rises above the pressure setpoint on the control pilot. The main valve and pilot valve shall close drip-tight if the upstream pressure drops below the pressure setting of the control pilot.
2. Full internal port design

3. Adjustment Range: 20 to 200 psi.
4. Operating Range:
 - a. Upstream Pressure: pilot setting between 120 to 140 psi
 - b. Downstream Pressure: 5 psi
5. Temperature Range: Water to 180 degrees F.
6. Main Valve Materials:
 - a. Body and Cover: Ductile Iron; ANSI B16.42 150-class flanges.
 - b. Disk Retainer & Diaphragm Washer: Cast Iron.
 - c. Trim (Disc guide, seat, and cover bearing): Stainless Steel.
 - d. Disc: Buna N Rubber, if applicable.
 - e. Diaphragm: Nylon reinforced Buna N, if applicable.
 - f. Piston: Cushioned and designed to insure positive closure, if applicable.
 - g. Stem, Nut, and Spring: Stainless Steel.
7. Pilot System Materials:
 - a. Pilot Control: Low lead bronze.
 - b. Trim: Stainless Steel Type 303.
 - c. Rubber: Buna N Synthetic Rubber.
 - d. Tubing and Fittings: Copper and Bronze.
 - e. Closing speed control.
8. Provide with the following options
 - a. Anti-cavitation trim as required based on upstream and downstream pressures as provided above.
 - b. Opening speed control needle valve.
 - c. Check feature to prevent reverse flow.
 - d. Valve position limit switch, single pole double throw, 120V rated contacts
9. Acceptable Manufacturers:
 - a. Cla-Val. 50-01
 - b. Singer 106-RPS
 - c. Prior Approved Equivalent.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install valves with stems upright or horizontal, not inverted (does not apply to plug valves).
- B. Install valves in the locations shown on Drawings. Verify configuration with Owner and Engineer.
- C. Manual valves located higher than seven feet shall be equipped with a chainwheel operator.
- D. Provide adequate structural support of installed valves as required.
- E. Install valves per manufacturer's recommendations.

- F. Valve tags to be installed so as not to interfere with valve operation.

3.02 PAINTING

- A. All material and equipment in this section shall be factory primed. Primer shall be compatible with finish coats of paint provided under Section 09 96 00.
- B. Finish painting of all materials and equipment in this Section that are not concealed shall be the responsibility of the General Contractor, and shall be as described in Section 09 96 00. Painting, unless otherwise specifically indicated.
- C. The Contractor shall, however, refinish and restore to the original appearance, all equipment that has sustained damage to the manufacturer's finish or prime coats of paint or enamel.

3.03 DISINFECTION

- A. Disinfection of valves shall be in accordance with Section 46 05 10 - Disinfection of Water Systems.

END OF SECTION

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SECTION 40 05 97
IDENTIFICATION FOR PROCESS EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Pipe Markers
 - 2. Valve Tags.
 - 3. The methods and materials specified herein apply to all piping and equipment in Division 40.
- B. Related Sections Include:
 - 1. Section 01 33 00 – Submittal Procedures
 - 2. Section 01 45 00 – Quality Control
 - 3. Section 09 96 00 - High Performance Coatings
 - 4. Section 40 05 58 - Process Valves

1.02 REFERENCES

- A. Reference Standards Include:
 - 1. Recommended Standards for Water Works - 2.14 Piping Color Code.
 - 2. ANSI A13.1 - 1981: Schemes for Identification of Piping Systems.

1.03 QUALITY ASSURANCE

- A. Standards: Comply with standards specified herein and in accordance with Section 01 45 00.
- B. Qualifications of Manufacturer: Provide Products specified in this Section from manufacturers regularly engaged in the manufacture of similar items and with a history of successful production acceptable to the Engineer.
- C. Qualifications of Installers: Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

1.04 SUBMITTALS

- A. Submit color schedule under provisions of Sections 01 33 00 and 09 96 00.
- B. Submit location drawing and shop drawings on markers under provisions of Section 01 33 00.

PART 2 PRODUCTS

2.01 PIPE MARKERS

A. Pipe Size ¾ inch through 6 inch Diameter:

1. One (1) piece, snap around and completely encircle pipe with substantial overlap and permanent tension to grip pipe firmly without adhesives.
2. Provide with flow arrows.
3. Clearly indicate "name" of line.
4. Size of Legend Letters and Numbers:

Outside Diameter of Pipe or Pipe Covering	Size of Legend Letters and Numerals
¾" to 1-1/4"	1/2"
1-1/2" to 2"	¾"
2-1/2" to 6"	1-1/4"

5. Comply with ANSI Standard A13.1 - 1996.
6. Material: Pre-formed acrylic/vinyl plastic.
7. Working printed in a "repeat and reverse" pattern.
8. Adhesive markers will not be allowed.
9. Approved Manufacturers:
 - a. W.H. Brady Co.
 - b. Seton Nameplate Corp.
 - c. Chemelex Div., Raychem Corp.
 - d. Koibi Industries, Inc.
 - e. John P. Nissen Jr. Co.
 - f. Zippertubing Co.
 - g. Prior Approved Equivalent.

B. Pipe Size 8 inch Diameter and Larger:

1. After process pipe has been finish coated per Section 09 96 00, apply pipe name with painted on stenciling.
2. Provide each label with flow arrow adjacent to text.
3. Size of Legend Letters and Numbers:

Outside Diameter of Pipe or Pipe Covering	Size of Legend Letters and Numerals
8" to 10"	2"
Over 10"	3"

4. Paint on each pipe at 120 or 180 degree intervals based on pipe size and location. Arrange so labeling of similar pipe runs are spaced and oriented the same. Coordinate label placement with Owner and Engineer.

5. Stack stencil wording where applicable. Paint flow arrow at end of wording in direction of flow. Center flow arrow between words in vertical direction.
6. Coordinate and maintain consistent spacing and stencil locations from filter to filter, between flanges, and within plant walls and penetrations for neat appearance.
7. Stencil paint color shall be Black to provide required contrast between process pipe coating and stencil identification.

2.02 VALVE TAGS

- A. Furnish brass valve tags for all exposed process valves size 4-inch or larger. Tags to consist of 2-inch round, black-filled numbering of valves as indicated on the Drawings. Tags to be attached to valve operators or bodies with brass beaded chain.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Pipe Markers:
 1. Install on all piping systems at the following locations or at Engineer's direction:
 - a. Adjacent to each valve.
 - b. Each branch and riser at take-off.
 - c. At each pipe passage through wall or floor.
 - d. At not more than 20 feet spacing on straight pipe runs.
 - e. At each change in direction.
- B. Painting:
 1. Finish painting of all materials and equipment shall be the responsibility of the Contractor, and shall be as described in Section 09 96 00.
 2. Colors: As indicated in schedule.
- C. Provide 6 inch bands at 30 inch intervals where banding is required.
- D. Valve tags to be installed so as not to interfere with valve operation.

3.02 PIPE COLOR CODE SCHEDULE

- A. Color code piping in accordance with the schedule presented in Section 09 96 00 - High Performance Coatings.

END OF SECTION

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SECTION 40 27 97
PROCESS GAUGES

PART 1 **GENERAL**

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installation of the following, as indicated, in accordance with the provision of the Contract Documents:
 - a. Pressure Gauges.

B. Related Sections include:

1. Section 01 33 00 – Submittal Procedures
2. Section 01 45 00 – Quality Control
3. Section 01 61 00 – Common Product Requirements
4. Section 01 75 00 – Starting and Adjusting
5. Section 01 77 00 – Closeout Procedures
6. Section 01 78 23 – Operations and Maintenance Data
7. Section 40 05 07 - Hangers and Supports for Process Piping
8. Section 40 05 23 - Stainless Steel Process Pipe and Tubing
9. Section 40 05 24 - Steel Process Pipe
10. Section 40 05 58 - Process Valves

1.02 SUBMITTALS

- A. Shop Drawings and Product Data: Submit, Under Provisions of Section 01 33 00, on all materials and products specified in this Section.

1.03 REGULATORY REQUIREMENTS

- A. All products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each product.

PART 2 **PRODUCTS**

2.01 WORKING PRESSURE

- A. Working pressure of pipe specialties to be equal to working pressure of connecting pipes, unless specified otherwise.

2.02 APPROVED MANUFACTURERS

A. Pressure Gauges:

1. Grade 1A accuracy brand and model
 - a. Wika
 - 1) 111.25 DW
 - b. Trerice
 - 1) 750LFSS
2. Grade 2A accuracy brand and model
 - a. Trerice
 - 1) 450LFB
 - b. US Gauge
 - 1) Model 1981
 - c. Ashcroft
 - 1) Model 1279-S Duragauge

2.03 PRESSURE GAUGES

- A. Lower stem mounted, 4-1/2" size, fiberglass reinforced polypropylene case with phosphor bronze tube. Gauges shall be selected so that normal operating pressures fall at approximately mid scale and so that continuous operation does not exceed 75% of full scale.
- B. Provide with dial having white background and black figures and graduations. Pointer shall be micro-adjustable.
- C. Install brass tee handle cock on each pressure gauge.
- D. Fill gauge with glycerin.
- E. Taps and bends: As required for proper positioning of gauge for reading and maintenance.
- F. Accuracy shall be ASME Grade 2A per ANSI B40.1 1980 or better.
- G. Stopcocks: Trerice Series 865L gauge cock. Provide required brass nipples and associated piping accessories for a complete and functional installation.
- H. Pressure Impulse Dampeners: Trerice Series 870 suitable for water service.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install gauges with shut off cocks in straight runs of piping so that they may be read from floor.
- B. Provide extension necks on pressure taps in insulated piping, vessels, and equipment.
- C. Provide isolating seal complete with bleed/fill screw where process media are injurious to gauge internals or otherwise required.
- D. Install pressure gauges at all locations indicated on the Drawings.

END OF SECTION

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SECTION 40 70 01
INSTRUMENTATION GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 REFERENCES

- A. Reference Standards:
 - 1. NFPA) 70 - National Electrical Code (NEC)
 - 2. National Electrical Manufacturers Association (NEMA)
 - a. NEMA ICS-2 - Industrial Control Devices, Controllers and Assemblies
 - b. NEMA 250 - Enclosures for Electrical Equipment
 - 3. Underwriters Laboratories (UL) - 508 Industrial Control Equipment

1.02 SCOPE

- A. It is the intent of the Contract Documents that all equipment specified in this Section of the specification be supplied by the same single-source supplier ("Hardware Systems Integrator") specified in Section 40 61 13 - Process Control System General Requirements unless noted otherwise herein or on engineer's drawings. The supplier shall assume full responsibility along with the Contractor for furnishing, installing and start-up procedures so as to make the system operate per the intent of the Contract Documents.
- B. The Work specified in this Section includes furnishing, installing, start-up, testing and adjusting of all required equipment, including instruments, equipment, hardware, software, wiring, accessory equipment, and training to provide a completely operational process instrumentation and control system.
- C. It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The Contractor shall be responsible for all details that may be necessary to properly install, adjust and place in operation the complete installation. The Contractor shall assume full responsibility for additional costs that may result from unauthorized deviations from the Contract Documents.
- D. It shall be the responsibility of the Contractor and supplier to examine all new equipment that is transmitting a signal to, or receiving a signal from, equipment specified in this Section and the associated instrumentation Sections. The Contractor shall be responsible for providing signal converters, buffer amplifiers, and isolation devices to make signal levels, reference to ground, etc. compatible between devices specified in this Section and existing equipment.

1.03 SUBMITTALS

- A. All submittal requirements stated herein shall be in addition to those outlines section 01 33 00 - Submittal Procedures.
- B. Shop Drawings:
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Equipment catalog cut sheets.
 - c. Instrument data sheets:
 - 1) ISA S20 or approved equal.
 - 2) Separate data sheet for each instrument type.
 - d. Materials of construction.
 - e. Minimum and maximum flow ranges.
 - f. Pressure loss curves.
 - g. Physical limits of components including temperature and pressure limits.
 - h. Control panel and junction box drawings including system schematic drawings, terminal numbering, component schematic drawings, dimension drawings, layout drawing and nameplate schedule. Where panels, junction boxes and new Owner-furnished equipment is being utilized, the submittal shall include complete schematics showing all proposed equipment, terminals, terminal numbering, wiring, elevations, and details. It shall be the supplier's responsibility to visit the Site and inspect existing and Owner-furnished equipment to prepare complete system drawings for the Project.
 - i. Overall system diagram showing all components, converters, cables, and connectors.
 - 2. Provide a parameter setting summary sheet for each field configurable device.
 - 3. Certifications:
 - a. Documentation verifying that calibration equipment is certified with NIST traceability.
 - b. Approvals from independent testing laboratories or approval agencies, such as UL, FM or CSA.
 - 1) Certification documentation is required for all equipment for which the specifications require independent agency approval.
- C. Technical data in conformance with Section 01 33 00 - Submittal Procedures and including:
 - 1. All equipment and components indicated on the Drawings and specified in Part 2 of this Section

- 2. Junction Box Enclosures
- D. Manufacturer's Instructions
 - 1. Furnish under provisions of Section 01 35 16.01 - LEED 2009 Material Cost Summary Form.
- E. Manufacturer's Field Service Reports
 - 1. Furnish under provisions of Section 01 35 16.01 - LEED 2009 Material Cost Summary Form. Reports should cover a minimum of startup, demonstration, and operational instructions.
- F. Operation and Maintenance data in conformance with Section 01 35 16.01 - LEED 2009 Material Cost Summary Form and including:
 - 1. Panel equipment, junction boxes, field devices and instruments, including "as-built" system schematics. All items requested under Part 2 below should be included in their "as-built" form.
- G. Spare Equipment Lists - Provide a list of recommended spare parts and equipment that is considered essential to the operation of the system. Include list of current prices for each item. These lists may be included with the Operation and Maintenance data submittals.
- H. All submittals shall be searchable documents in PDF file type. They shall be electronically delivered through the platform/method all parties mutually agreed upon. The submittal shall be broken up into sections and bookmarked to allow for easier navigation throughout the submittal.

1.04 CIRCUIT IDENTIFICATION

- A. Each power, control, and signal conductor shall be identified by plastic tags permanently attached to the cable. The tags shall be attached to each cable at each termination and wherever the cable is accessible in junction or pull boxes. Tags shall be marked with printing showing:
 - 1. The circuit number from the cable and conduit schedules.
 - 2. The terminal number as assigned by the equipment manufacturer.
- B. The cable marking system shall use transparent tape with a white area where the numbering shall be typed using a typewriter or computer, as manufactured by:
 - 1. Raychem
 - 2. Thomas & Betts
 - 3. Brady

- C. Contractor supplied "as-built" schematics and wiring diagrams should reflect this described wire identification.

1.05 REGULATORY REQUIREMENTS

- A. All Products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60 and 61, as appropriate. A Product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each Product.

PART 2 PRODUCTS

2.01 REFER TO THE FOLLOWING PRODUCT SECTIONS

- A. Level Measurement - See Section 40 72 00
- B. Pressure, Strain, and Force Measurement - See Section 40 73 00
- C. Temperature Measurement - See Section 40 74 00

PART 3 EXECUTION

3.01 LABELING

- A. Label all field mounted control devices, instrumentation, switches, etc., with tag number (if applicable) and item description.
- B. Labels shall be engraved laminated plastic with 1/4" high lettering. Labels shall be attached with stainless steel screws to the device or nearby wall.

3.02 CALIBRATION, ADJUSTING AND TESTING

- A. Devices requiring field calibration shall be calibrated in the presence of the Engineer's representative and documented.

3.03 PROJECT MANAGEMENT

- A. Supplier shall provide engineering and administrative services necessary to fulfill the requirements of this Specification.
- B. Supplier shall provide the services of an experienced project manager as the overall coordinator during the course of the project.

3.04 FIELD QUALITY CONTROL

- A. Maintain accurate daily log of all startup activities, calibration functions, and final setpoint adjustments.

- B. Install all instrumentation and equipment as per manufacturer's requirements. Coordinate with Engineer in Field on final instrument locations per manufacturer requirements.
- C. Instrumentation Calibration:
 - 1. Verify and document that all instruments and control devices are calibrated to provide the performance required by the Contract Documents.
 - a. Utilize the Instrument Certification Sheet located at the end of this Specification Section (or Engineer approved equivalent) to document on-site calibration checks.
 - 2. Factory furnished calibration certifications are acceptable for the following:
 - a. Flow meters.
 - b. Pressure sensors utilized with annular sleeve.
 - c. Temperature sensors.
 - 3. On-site calibration verification is required for all other instruments, including "smart" transmitters that have been factory calibrated.
 - a. Provide calibration checks at 0 PCT, 25 PCT, 50 PCT, 75 PCT and 100 PCT of span for pressure transmitters and gages.
 - 1) Check for both increasing and decreasing input signals to detect hysteresis.
 - b. In addition to factory calibration certification, temperature sensors and gages shall be checked at a single point for conformance to required accuracy.
 - c. Level transducers/transmitters shall be checked at two points in addition to zero.
 - d. Analytical sensors shall be calibrated in accordance with manufacturer's recommendations.
 - e. Check operation of all switches to verify actuation occurs in accordance with manufacturer's specified accuracy.
 - f. Replace any instrument which cannot be properly adjusted.
 - g. Stroke pneumatic control valves with clean dry air to verify control action, positioner settings, and solenoid functions.
 - 4. Calibration equipment shall be certified by an independent agency with traceability to NIST.
 - a. Certification shall be up-to-date.
 - b. Use of equipment with expired certifications shall not be permitted.
 - 5. Calibration equipment shall be at least three times more accurate as the device being calibrated.
- D. Loop Check-Out Requirements are as Follows:
 - 1. Work closely with the Owner to check control signal generation, transmission, reception and response for all control loops under simulated

operating conditions by imposing a signal on the loop at the instrument connections. Loop check-out work shall verify proper operation of the installed equipment and the Owner's PLC and HMI programming.

- a. Use actual signals where available.
 - b. Closely observe controllers, indicators, transmitters, HMI displays, recorders, alarm and trip units, remote setpoints, ratio systems, and other control components.
 - 1) Verify that readings at all loop components are in agreement.
 - 2) Make corrections as required.
- 1) Following any corrections, retest the loop as before.
 - 2. Stroke all control valves, cylinders, drives and connecting linkages from the local control station and from the control room operator interface.
 - 3. Check all interlocks to the maximum extent possible.
 - 4. Utilize the Loop Check-Out Sheet located at the end of this Specification Section (or Engineer approved equivalent) to document on-site calibration checks.
 - 5. In addition to any other As-Recorded Documents, record all setpoint and calibration changes on all affected Contract Documents and turn over to the Owner.

3.05 FIELD QUALITY CONTROL - INSTALL, START-UP AND WITNESS TESTING

- A. Contractor shall furnish and install raceway and wiring systems for the instrumentation and control system in accordance with manufacturer's requirements and in accordance with Sections 26 05 34 - Conduit. All instrumentation and control system raceways shall be galvanized rigid steel conduit unless specifically indicated otherwise.
- B. Supplier shall provide a skilled programmer/instrumentation engineer or technician who shall complete troubleshooting and start-up to place the entire system into satisfactory operation. The engineer or technician shall make the necessary inspection of the completed installation, make the necessary final field adjustments, and make program revisions as required for start-up.
- C. Coordinate installation, start-up and testing scheduling with Owner and Engineer.
- D. Instruct Owner's personnel at the Site on the operation and maintenance of equipment furnished in this Section.
- E. Furnish Owner and Engineer with a written report prepared by Supplier certifying that equipment:
 - 1. Has been properly installed.

2. Is in accurate alignment and calibration and is free from undue stress imposed by interconnecting cable/conduit, etc.
3. Has been operated and witness demonstrated to the Owner under expected conditions and that it operates satisfactorily.

3.06 ON-SITE SERVICES

- A. In addition to other services specified, provide a competent instrumentation engineer or technician to perform the following services:
 1. Training – one (1), four (4) hour days on-Site to train Owner's personnel on operation and maintenance of all equipment furnished under this Section.
- B. All on-Site service shall be at times approved by the Owner.

END OF SECTION

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SECTION 40 72 00
LEVEL MEASUREMENT

PART 1 GENERAL

1.01 REFER TO PART 1 GENERAL OF SECTION 40 70 01 - INSTRUMENTATION
GENERAL REQUIREMENTS .

PART 2 PRODUCTS

2.01 FLOOD SWITCH

A. General Specifications

1. Electrical
 - a. Two wire termination
 - b. SPST contacts
 - c. 120VAC 20VA rated
2. Nominal Operating Differential: 1-3/8"
3. Manufacturer supplied extra flexible cord of sufficient length to reach
junction box as indicated on plans with waterproof connection to sensor

B. Schedule

1. Flood Float Switches shall be furnished and installed for the following
application(s):
 - a. LSH-02562

C. Manufacturer/Model

1. Gem Sensors LS-270 Series – P/N: 43760
2. Prior Approved Equal

PART 3 EXECUTION

3.01 REFER TO PART 3 EXECUTION OF SECTION 40 70 01 - INSTRUMENTATION
GENERAL REQUIREMENTS.

END OF SECTION

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SECTION 40 73 00
PRESSURE MEASUREMENT

PART 1 GENERAL

- 1.01 REFER TO PART 1 GENERAL OF SECTION 40 70 01 - INSTRUMENTATION
GENERAL REQUIREMENTS .

PART 2 PRODUCTS

2.01 PRESSURE TRANSDUCER - STANDARD

A. General Specifications

1. Housing Material: Aluminum
2. Input Voltage: 10.5-42.5 VDC Loop Powered
3. Output Signal: Two (2) Wire 4-20mA HART
4. Display/Interface: LCD Display with full Local Operator Interface
5. Configuration Buttons: Analog Zero and Span
6. Diaphragm Type: Isolated
7. Diaphragm Fill Fluid: Silicone
8. Diaphragm Material: 316L SS
9. Accuracy (Min): +/- 0.075% of Calibrated Span
10. Long term stability (Min): +/-0.15% of URL or better
11. Turndown: 10:1 or better
12. Sensing Range: Refer to IO Schedule
13. Temperature Ratings: -40-190°F
14. Process Connection (Application Dependent): 1/2" NPT

B. Schedule

1. Pressure Transducers shall be furnished and installed for the following application(s):
 - a. PIT-02501

C. Manufacturer/Model

1. Endress+Hauser Cerabar S PMP71
2. Rosemount 2088G
3. Prior Approved Equal

2.02 PRESSURE SWITCH - STANDARD OR DIFFERENTIAL

A. Switch General Specifications

1. Type: Diaphragm Actuated
2. Setpoint Adjustment: Field Adjustable

3. Deadband Adjustment: Field Adjustable
4. Contact Rating: General Purpose DPDT, 10A at 120VAC
5. Enclosure Rating: Nema 4X
6. Over-Range / Burst Pressure: >Max Process Line Pressure
7. Connection Port Material: Stainless Steel. Contractor to verify compatibility with required liquids
8. Wetted Parts: Teflon-Coated or Viton
9. Conduit Connection: 3/4" NPT
10. Process Connection: 1/2" NPT

B. Additional Features/Options

1. Stainless Steel Tag
2. Chained Cover
3. Switch Mounted Indicator Light(s)

C. Accessories (As required per application)

1. Snubber
 - a. Size and Pressure: Compatible w/ switch served
 - b. Manufacturer/Model
 - 1) Ashcroft "Pulsation Dampers"
 - 2) Approved Equal
2. Diaphragm Seal
 - a. 1/2" NPT Thread-attached type
 - b. Compatible with the process fluid
 - c. Diaphragm seal along w/ switch shall be factory assembled, filled with a suitable fluid, and calibrated as a unit
 - d. Lower housing shall include a tapped and plugged 1/4" NPT flushing connection

D. Schedule:

1. Pressure Switches shall be furnished and installed for the following application(s):
 - a. PSH-02551
 - b. PSH-02552
 - c. PSH-02553

E. Manufacturer/Model:

1. Ashcroft B-Series Type 400

PART 3 EXECUTION

3.01 REFER TO PART 3 EXECUTION OF SECTION 40 70 01 - INSTRUMENTATION
GENERAL REQUIREMENTS.

END OF SECTION

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SECTION 40 74 00
TEMPERATURE MEASUREMENT

PART 1 GENERAL

- 1.01 REFER TO PART 1 GENERAL OF SECTION 40 70 01 - INSTRUMENTATION
GENERAL REQUIREMENTS.

PART 2 PRODUCTS

2.01 AMBIENT AIR TEMPERATURE INDICATOR TRANSMITTER (TIT)

A. Transmitter General Specifications

1. Continuous averaging, 1000 ohm, suitable for wall mounting platinum
RTD type temperature sensor
2. Shall be of same manufacturer as the sensor and calibrated for use
3. Electrical Connection: M20 Cable Gland, 2 Wire
4. Power Requirements: 4-20 mA Loop Powered
5. Output Signal: 4-20 mA
6. Operating Range: -40 to 18°F
7. Stainless Steel Tag

B. Sensor General Specifications

1. Accuracy: $\pm 0.1^{\circ}\text{F}$, $\pm 0.05\%$ of reading
2. Thermal Drift: 0.0025% / °C
3. Response Time: 1 Second (90% Response)
4. Internal Resistance: 1000 Ohms

C. Schedule

1. Temperature sensor and transmitter shall be furnished and installed for
the following application(s):
 - a. TIT02519

D. Manufacturer/Model

1. Devar Inc. d-RTTI
2. Prior Approved Equal

2.02 AMBIENT AIR TEMPERATURE SWITCH

A. Temperature Switch General Specifications

1. Enclosure Rating: NEMA Type 4X. IP66 and IP68
2. Electrical: 120VAC, Suitable for 24VAC @100mA minimum

3. Switch Action: SPDT
4. Stability: ± 2.5 °F
5. Stainless Steel Tag

B. Schedule

1. See instrumentation schedule in the "Specifications" drawings.

C. Spares

1. Provide one (1) complete spare temperature switches.

D. Manufacturer/Model

1. Chromalox WCRT-100
2. Prior Approved Equal

2.03 TEMPERATURE SENSOR/TRANSMITTER

A. Transmitter General Specifications

1. Stability: $\pm 0.1\%$ or 0.1 degrees C for 24 months
2. Enclosure Rating: NEMA Type 4X. IP66 and IP68 Rated
3. Electrical Connections: One (1) 1/2" NPT Conduit Entry
4. Electrical: 12 to 42.4 VDC
5. Signal Output: 4-20 mA w/ HART
6. Display: 5-digit LCD w/ 0-100% bar graph
7. Stainless Steel Tag

B. Sensor/Thermowell General Specifications

1. Sensor Conformance: IEC 751
2. Accuracy: ± 0.18 deg F $\pm 0.02\%$ of span
3. Range: -50 to 450 F
4. Stability: $\pm 0.11\%$
5. Temperature coefficient: 0.00385 ohm/ohm/degree C
6. Sensor Type: Spring-loaded with Contact Indication
7. Sensor/Immersion Length: As need for each individual application
8. Response time in water @ 3 ft/s (63.2% response): 12 sec
9. Thermowell Material: 316 Stainless Steel
10. Thermowell Style: 3/4"-14 NPT Tapered

C. Transmitter and Sensor shall come pre-assembled.

D. Approvals

1. NSF Drinking Water

E. Schedule

1. Shall be provided for liquid applications.
2. See instrumentation schedule in the "Specifications" drawings.

F. Manufacturer/Model

1. Rosemount – 3144P Series w/ Series 214C RTD

2.04 TEMPERATURE SWITCH - STANDARD OR DIFFERENTIAL

A. Sensor/Transmitter General Specifications

1. Type: Ambient Compensated with Integral Sensor
2. Setpoint Adjustment: Field Adjustable
3. Deadband Adjustment: Field Adjustable
4. Contact Type and Ratings
 - a. One (1) DPDT or Two (2) SPDT
 - b. 15A at 125VAC and 0.5A at 125VDC
5. Enclosure Rating: Nema 4X 316 SS
6. Temperature Range: As shown on the IO Schedules
7. Process Material: 316 SS
8. Sensor/Immersion Length: As need for each application
9. Conduit Connection: 3/4" NPT
10. Process Connection: 3/4" NPT
11. Thermowell Type: Straight Shank
12. Stainless Steel Tag
13. Chained Cover
14. Switch mounted Indicator Light(s)

B. Schedule

1. Shall be provided for liquid applications.
2. See instrumentation schedule in the "Specifications" drawings.

C. Manufacturer/Model

1. Ashcroft G-Series
2. Prior Approved Equal

PART 3 EXECUTION

3.01 REFER TO PART 3 EXECUTION OF SECTION 40 70 01 - INSTRUMENTATION GENERAL REQUIREMENTS.

END OF SECTION

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DIVISION 43 PROCESS GAS AND LIQUID HANDLING, PURIFICATION AND STORAGE EQUIPMENT

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SECTION 43 21 13
VERTICAL TURBINE PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Furnishing and installation of the following pumps, in accordance with the provisions of the Contract Documents.
 - a. Vertical Turbine Pumps.

B. Related Sections include:

1. Section 01 33 00 – Submittal Procedures
2. Section 01 45 00 – Quality Control
3. Section 01 61 00 – Common Product Requirements
4. Section 01 75 00 – Starting and Adjusting
5. Section 01 77 00 – Closeout Procedures
6. Section 01 78 23 – Operations and Maintenance Data
7. Section 01 79 00 – Demonstration and Training
8. Section 09 96 00 – High Performance Coatings
9. Division 26 – Electrical

1.02 REFERENCES

A. Reference Standards:

1. HI - Hydraulic Institute Standards.
2. ASTM - American Society for Testing and Materials.
3. AISI - American Iron and Steel Institute.
4. ANSI - American National Standards Institute.
5. American Water Works Association, AWWA E101-88 Vertical Turbine Pumps – Line Shaft and Self-Priming Types.
6. AGMA - American Gear Manufacturing Association
7. AISC - American Institute of Steel Construction
8. AISI - American Iron and Steel Construction
9. AWS - American Welding Society
10. AFBMA - Anti-Friction Bearing Manufacturers Association
11. IEEE - Institute of Electrical and Electronics Engineers
12. NEC - National Electrical Code
13. NEMA - National Electrical Manufacturers Association
14. OSHA - Occupational Safety and Health Administration
15. UL - Underwriters Laboratories, Inc
16. NSF - National Science Foundation

1.03 SUBMITTALS

- A. Shop Drawings: Furnish in accordance with Section 01 33 00. Provide the following information for each pump specified within this Section, if applicable, and identify all other materials or equipment, dimensions, components, properties, and other information required to prove compliance with these specifications.

1. Pumps:

- a. Name of manufacturer.
- b. Type of model.
- c. Design rotative speed.
- d. Number of stages.
- e. Type of pump bearings.
- f. Type of lineshaft bearings.
- g. Size of shafting.
- h. Size of pump column and length.
- i. Size of suction and discharge.
- j. Type of impeller.
- k. OD of impeller.
- l. Weight of complete assembly, including motor.
- m. Complete performance curves showing capacity, head, NPSH requirements, efficiency, and bhp requirements and curves showing pump on VFD.
- n. Type of seals.
- o. Mounting hardware assemblies, as applicable.
- p. Materials of component construction.
- q. Data on shop painting.
- r. List of spare parts.

2. Motors:

- a. Name of manufacturer.
- b. Type and model.
- c. Rated size of motor (hp).
- d. Type of bearings.
- e. Weight.
- f. Service factor.
- g. Insulation class.
- h. Voltage, cycles, and phase.
- i. Nominal and guaranteed efficiencies and power factor.
- j. Complete drawings showing dimensions, fabrication, installation, and manufacturers requirements.
- k. Temperature rating.
- l. Full load rotative speed.
- m. Full load current.
- n. Locked rotor current.
- o. Motor power cable.
- p. Conform to requirements for NEMA Premium® Motor Nominal Efficiency as identified in Specification Section 26 05 10.

- B. Manufacturer's Instructions: Furnish in accordance with Section 01 61 00, manufacturer's printed instruction for delivery, handling, storage, assembly, installation, startup, adjusting, balancing, and finishing as appropriate.
- C. Manufacturer's Report: Submit reports for starting of systems and systems demonstration.
- D. Operation and Maintenance Data: Submit in accordance with Section 01 78 23.
- E. Resonant Frequency Analysis: The pumping unit shall be deigned to safely operate free of resonant frequency. A natural frequency analysis of the head, motor stand (if applicable), and electric motor shall be performed by a licensed Professional Engineer using FEA software. A report shall be provided with the submittal showing that the natural frequencies and mode shapes of the pump and motor have been considered in the design of the discharge head, and certify that the critical frequency is at least 20% above or below the operating range.
- F. Torsional Frequency Analysis: A torsional natural frequency analysis shall be performed on the rotating assembly consisting of, the electric motor rotor, shafting, couplings and impellers. A steady-state forced response analysis shall also be performed as deemed necessary by the pump manufacturer. The analysis is to be performed by a licensed Professional Engineer using rotordynamic FEA software. A report shall be provided with the submittal containing the torsional interference diagram and mode shapes. If the steady-state response analysis is performed, a fatigue diagram using the Goodman criterion must also be provided.
- G. Lateral Damped Analysis: A lateral damped natural frequency analysis shall be performed on the bearing supported rotating assembly consisting of, the electric motor rotor, shafting, couplings and impellers with seal effects. A steady-state unbalanced response analysis shall also be performed as deemed necessary by the pump manufacturer. The analysis is to be performed by a licensed Professional Engineer using rotordynamic FEA software. A report will be provided with the submittal showing a lateral interference diagram and the precessional mode shapes and logarithmic decrement of each interference. If the steady-state unbalanced response analysis is performed, Bode diagrams and precessional orbits must be provided
- H. Shop Tests:
 - 1. Each pump shall be tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, shutoff head or point of discontinuity, and at as many other points as necessary for accurate performance curve plotting. Tests shall be run at maximum, minimum, and specified operational points. All tests and test reports shall conform to

the requirements and recommendations of the Hydraulic Institute (HI) Standards.

- a. HI Grade 1
 - 1) 1B

- 2. Three (3) certified copies of a report covering each test shall be prepared by the pump manufacturer and delivered to the Engineer not less than 10 days prior to the shipment of the equipment from the factory. The report shall include data and test information as stipulated in the Hydraulic Institute Standards; copies of the test log originals; test reading to curve conversion equations; and calculated field performance curves, based on shop tests and corrected for head losses in all portions of the pump column and for shaft bearing losses not included in the shop tests. The curves shall include pump total head, pump efficiency, and rpm, plotted against capacity. The curves shall be easily read and plotted to scales consistent with performance requirements, with all test points clearly shown. When the pump is not tested at the rated speed, performance charts shall include both the test speed and the calculated speed curves.
- 3. Certified motor and variable frequency drive efficiency data, if applicable, shall be included in the report.

I. Certificates:

- 1. Certification of proper installation and satisfactory performance.
- 2. Warranties for motor and pump.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Box, crate, or otherwise completely enclose and protect all equipment during shipment, handling, and storage.
- B. Protect equipment from exposure to elements and keep all items thoroughly dry at all times.
- C. Painted Surfaces: Protect against impact, abrasion, discoloration, and other damage.
- D. Protect electrical equipment, controls, and insulation against moisture or water damage.

1.05 MAINTENANCE AND SERVICE

- A. Manufacturer's authorized representative shall have his own full time repair service available on 24-hour call.

- B. A factory serviceman and service vehicle equipped with tools to make all necessary repairs, as well as component parts required to maintain satisfactory operation of the equipment outlined in these specifications, shall be available if needed, without undue delay.

1.06 PAINTING AND IDENTIFICATION SYSTEMS

- A. All material and equipment in this section shall be factory finish coated. Finish coat shall be compatible with finish coats of paint provided under Section 09 96 00.
- B. Finish painting of all materials and equipment in this section that are not concealed shall be as described in Section 09 96 00, unless specifically indicated.
- C. Identification of all equipment and piping in this section that is not concealed shall be provided under the provisions of Section 40 05 97.
- D. The Contractor shall refinish or restore to original appearance, all equipment that has sustained damage to the manufacturer's finish and prime coats of paint or enamel.

1.07 REGULATORY REQUIREMENTS

- A. All products that may come into contact with water intended for use in a public water system shall meet American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International Standards 60, 61 and 372, as appropriate. A product will be considered as meeting these standards if so certified by NSF, the Underwriters Laboratories, or other organization accredited by ANSI to test and certify each product.

1.08 EQUIPMENT NAMEPLATES

- A. Provide stainless steel nameplates on all pumps and motors.
- B. Include manufacturer, model number, capacity, total dynamic head, rpm, efficiency, and additional motor information required by NEMA.

1.09 SPARE PARTS

- A. Provide one spare mechanical seal assembly for each size of pump provided.
- B. Spare parts shall be suitably packaged in accordance with the General Equipment Stipulations, with labels indicating the contents of each package. Spare parts shall be delivered to the Owner as directed.

1.10 WARRANTY

- A. The pump manufacturer/supplier shall warrant the units being supplied to the Owner against defects in workmanship and materials for a period of one (1) year, from the date of Final Completion. The warranty shall be in printed form and apply to all similar units. No prorated warranty will be accepted. Pump removal, shipping and reinstallation will be covered under this warranty.

PART 2 PRODUCTS

2.01 GENERAL

- A. The complete pump assembly, defined as the pump bowl, column, line shaft, discharge head, pump can, motor, and pump can venting equipment for three pumps shall all be supplied by the same pump manufacturer and supplier.
 - 1. Pump cans with bolted cover plates for the top of the can shall be provided where the three future pumps are designated as shown on the drawings. The future pumps are intended to be the same size as the pumps installed as part of this project, coordination of can sizing for these pumps will be completed during submittal review process.
 - 2. The pump cans may be constructed by the pump supplier in coordination with the pump manufacturer for proper sizing to meet hydraulic institute standards. The pump supplier shall provide proof of welders certified by AWI with the shop drawings.
- B. These vertical turbine pumps will be pumping drinking water with free chlorine residual disinfectant. Manufacturer shall note the use of chlorine disinfectant and any impacts it may have to rubber or metal materials used on the pump.
- C. Accurately machine all rotating parts so as to provide dynamically balanced units.
- D. Excessive vibration shall be sufficient cause for rejection of equipment. See part 3 of this specification for vibration testing requirements.
- E. Prevent resonance at normal operating speeds based on mass of unit and its operating speeds.
- F. Pumps shall provide constantly increasing head characteristics from design condition to shutoff head.
- G. Pumps shall be capable of operating without overloading electric motor, starter, or VFD drive.
 - 1. All pumps and motors within this specification shall be capable of being operated by a variable frequency drive.

2. The variable frequency drive shall meet the requirements of the variable frequency drives specified in Division 26 and as indicated on the electrical drawings. The pump manufacturer shall be responsible for coordinating the collection of data for both the motor and the drive to ensure a complete operational system which limits harmonics and potentially damaging motor overvoltages (spikes) to the levels specified.
 3. The variable frequency drive manufacturer shall be responsible for providing to the pump/motor manufacturer any data required to ensure that a complete and properly operating system is furnished. A letter confirming that required data was provided as specified shall be included in the submittal package.
 4. All equipment for the load shall be derated as recommended by the motor and drive manufacturer for reduced speed operation with a variable frequency drive.
- H. All motor starting equipment, electric controls, and associated equipment shall be provided as specified in Division 26.

2.02 VERTICAL TURBINE PUMPS

A. Approved Manufacturers:

1. National Pump Company (E18LC for 4200 gpm and K20MC for 5600 gpm)
2. Flowserve (20EKL for 4200 gpm and 18ENL for 5600 gpm)
3. Fairbanks Nijhuis (18H-SS for 4200 gpm and 19B SS for 5600 gpm)
4. Prior Approved Equivalent.

B. General:

1. Comply with AWWA Standard E101, meet all requirements of this standard including and following supplementary provisions and modifications.
2. Each pump shall be designed to limit the column lengths to sections of 5 feet maximum to facilitate installation and removal.

C. Materials:

1. Bowls: Cast Iron, minimum tensile strength of 30,000 psi, free from blowholes, sand holes, and other faults.
2. Suction Bell: Cast Iron, similar to bowl material
3. Suction Strainer: 304 Stainless Steel
4. Impeller: Bronze B148-C954, enclosed type, accurately fitted, locked securely to the impeller shaft with a tapered lock bushings collets or keys and snap rings.

5. Lineshaft: Stainless Steel, Type 416, ASTM A582-88a, turned and ground
6. Lineshaft Coupling: Stainless Steel, Type 416, ASTM A582-88a
7. Lineshaft Sleeve: Stainless Steel, Type 304
8. Lineshaft Bearings: SBR, lubricated by product water.
9. Suction Bowl and Bell Bearings: Bronze C89835
10. Bowl and Impeller Wearing Rings: Cast Stainless Steel, CA-40 and CA-15, respectively
11. Column Pipe: Carbon Steel, ASTM A53, Grade A or B
12. Suction Can: Carbon Steel
13. Straightening Vanes: Pump manufacturer standard
14. Discharge Head: Fabricated Steel
15. Sole Plate: Fabricated Steel A36-Gr 70
16. Bolts and Fasteners: Stainless Steel
17. Mechanical Seal: John Crane or approved equivalent
18. Motor Coupler: Flanged spacer type

D. Motor:

1. All motors shall conform to the requirements of Division 26 including any additional motor components and equipment and with motor controllers/starters specified therein. Refer to Section 26 05 11 for additional motor requirements.
2. Vertical solid-shaft squirrel-cage induction type.
3. Motors shall be compatible with pump components in every respect.
4. Voltage and Phase: 480 volt, 3-phase, 60 Hertz; WP-1 enclosure with Class H insulation.
5. Windings shall be hermetically sealed to prevent water entry.
6. Ensure motors are suitable for VFD service and rated "Inverter duty" per specification Section 26 05 50.
7. Supply motors in conformance with NEMA MG1 Parts 30 and 31.
8. Motors shall have anti-friction (ball or roller) bearings, sized for a L-10 life of at least 100,000 hours under normal loading conditions. Bearings shall be AFBMA standard sizes. Motors shall be equipped with end shield-mounted ball bearings made to AFBMA standards, and be of ample capacity for the motor rating. The bearing housing shall be large enough to hold sufficient lubricant to minimize the need for frequent relubrication, but facilities shall be provided for adding new grease and draining out old grease without major motor disassembly. The bearing housing shall have long, tight, running fits or rotating seals to protect against entrance of foreign matter into the bearings, or leakage of grease out of the bearing cavity.
9. Service Factor: 1.15; insure motor operates without the use of the service factor at any point on pump capacity-head curve.

10. Tested in accordance with NEMA standards and labeled to indicate premium efficiency. Rated for continuous service at 40 degrees Celsius, minimum.
11. Provide a removable non-reverse mechanism to protect line shaft and motor from reverse rotation.
12. Provide thrust bearing in driver to carry the weight of the revolving parts of the pump, including unbalanced hydraulic thrust of the pump. Extra high thrust bearings may be necessary and depends upon pump selection.
13. Factory tested per IEEE Method B, dynameter test. Motor shall be fully calibrated at the factory to determine the efficiency.
14. Provide with lifting lugs capable of supporting weight of motor per manufacturer requirements.
15. Each motor shall be provided with an insulated or insulated/ceramic bearing on the non-drive end of the motor, and grounding ring on the drive end as specified in Section 26 05 11.
16. Each motor shall be of the "NEMA premium efficient" type and shall be provided with minimal nominal efficiencies.
17. Each motor shall be provided with internal motor winding (normally-closed contact) thermal overload protection with auto-reset: terminate all leads in easily accessible conduit box on motor enclosure; VFD controls specified in Section 26 29 23.
18. Each motor shall be provided with electronic vibration switch which uses 24 VDC power with 4-20 mA analog and relay output. Switch shall be housed in a weatherproof enclosure. Switch shall be Metrix-PMC model 440SR-2020-0220.
 - a. Provide same switch for installation on existing pump P3 motor as shown on drawings.
19. Each motor shall have 120V single phase 60 Hz space heaters.
20. Conduit box mountings shall be arranged so conduit can be brought in from top, bottom, or either side. Cast iron conduit boxes for all severe duty motors shall be a tapped or threaded conduit connection. Conduit hole size shall conform to NEC Standards, depending on motor rating.
21. Motor leads into conduit box shall have same insulation Class as the winding, and be equipped with a numbered brass or copper terminal staked or otherwise mechanically fastened to the lead sufficiently to resist 15 lbs pull. Leads shall be marked throughout the entire length to provide identification after terminals are taped or clipped.
22. The motor connection diagram shall be permanently attached to the motor either inside the conduit box or on the motor frame in a readable location from the conduit box side.

23. The motor shall be of cast iron construction with copper windings and a fan that is capable of providing adequate cooling air throughout the operating range of the motor.
24. Preparation for Shipment:
 - a. Before shipment, the shaft extension and any other bare exposed metal parts of each motor shall be coated with an easily removable rust preventative.
 - b. All motors shall be securely fastened to a hardwood skid or pallet for fork truck handling, and be covered for protection against dirt and moisture during transit and for short time outdoor storage.

E. Pump:

1. Pump Head:
 - a. The pump discharge outlet shall be integral with the pedestal. The discharge outlet shall terminate with a flange conforming to ANSI B16.1, Class 150.
 - b. Top of the head: Machined register to fit the specified motor.
 - c. Sufficiently sized to carry the complete weight of the pump and motor and withstand all possible hydraulic loads which might be imposed on it by the system.
 - d. Provide pump head with lifting lugs capable of supporting weight of entire unit.
 - e. The mounting face of the pump head shall be machined smooth.
 - f. Seals/Stuffing Box: No stuffing box shall be allowed. Mechanical seals are required for all pumps. All stainless steel welded bellow seal with synthetic rubber "O" ring secondary seal, carbon or tungsten carbide sealing face; J. Crane, Type 5610, or Flowserve ISC2.
 - g. Sub-base for Pump Head:
 - 1) A rigid sub-base with rounded corners shall be provided to support each pump head. Specifically designed and sized for the pump head. Abutting surfaces between the sub-base and the pump head shall be machined to provide uniform bearing.
 - 2) Center opening of sufficient size to remove or reinstall the entire pump assembly while the sub-base is left in place.
 - h. A ½-inch NPT tapped and plugged pressure gauge connection shall be provided on the horizontal center line of the pump discharge outlet. The size and configuration of the connection shall conform to Figures 2.6.17 and 2.6.18 of the Hydraulic Institute Standards.
 - i. A 1-inch NPT tapped threadedlet shall be provided on the top of the pump discharge outlet. Contractor shall provide a 1-inch stainless steel ball valve, pipe, and plug used to exhaust air from pump on initial filling of pump can and pump.

- j. A 1/2 inch NPT tapped threadolet shall be provided on the pump head to exhaust air in the pump can. Pump supplier shall provide stainless steel pipe nipples, ball valve, and air release valve selected for low pressure applications.
 - k. Pump discharge head shall be supplied by the same manufacturer as the pump impeller and column. The pump discharge head shall include a corresponding serial number to the original manufacturer.
2. Suction Can:
- a. Suction can shall be specifically designed for the pump head with a center opening of sufficient size to remove or reinstall the pump while the soleplate is left in place.
 - b. Pump manufacturer shall be responsible for proper size, design, and material selection of straightening vanes. Straightening vanes are required on all pumps with a nominal capacity of greater than 3,000 gpm. Provide in accordance with Hydraulic Institute Standards.
 - c. Maximum length of any can section is 15-feet. Suction can to be provided in sections with flanged joints and gaskets as needed. On site welding and coating may be required for installation of can through existing floor openings.
 - d. Provide with vent connection and venting valve apparatus at top of can or pump head. Pump supplier shall select size of air/vacuum valve. Hose shall be provided to direct the water released through the air/vacuum valve to nearby floor drains. Air/vacuum valve shall be capable of sealing at low pressure applications.
 - e. Provide with base plate at bottom of suction can to mount to floor of the pump station facility.
 - f. Provide with a 3,000 lb threadolet and plug near the bottom of the can for draining of can, see detail on drawings.
 - g. Refer to Drawings for layout of can.
3. Column:
- a. Maximum length of any column section: 5 feet, interchangeable.
 - b. Upper end of the column pipe flanged to the pump head.
 - c. Column sections:
 - 1) Up to 8-inch diameter: Threaded.
 - 2) 8-inch diameter and above: Flanged with stainless steel bolting.
 - d. Bottom column section: Properly adapted to connect to the bowl assembly.
 - e. Furnish bronze bearing retainers between column sections for supporting the lineshaft bearings.
 - f. See Drawings for pump setting and pumping system layout. An existing 1 ton rated bridge crane is available for on-site assembly of pumps.
4. Line Shafting:
- a. Provided with a Type 416 stainless steel two-piece topshaft.

- b. All shafting shall conform to the requirements of AWWA E101 and Hydraulic Institute Standards. Shaft diameter shall be not less than the minimum permitted for the applicable driver nameplate power rating.
- 5. Bowl Assembly and Suction Case:
 - a. To maximize efficiency, either provide a minimum of two bearings on top bowl, above the impeller, or provide a custom fabricated tapered column bottom section to match the throat of the top bowl, where a single bearing top bowl is acceptable
 - b. Intermediate bowls shall have combination bearings, one of which is bronze and the second bearing being fluted rubber. Bearings are to be lubricated by the product being pumped.
 - c. Suction bell bearings: The center hub housing the suction manifold bearing shall have an open cavity under the bearing that can be used for flushing the bearing if necessary. An opening through one of the hub vanes shall be provided from the outside of the suction bell to the cavity under the bearing. It shall be tapped on the outside and furnished with a pipe plug of the same material as the suction bell. The suction bell bearing shall be permanently packed with food grade grease, and shall have a length not less than 2 times the shaft diameter.
 - d. Bowls shall be equipped with wearing rings designed to maintain pump efficiency. Wearing rings shall be securely locked in place so that they will not move or loosen during any condition of operation or handling, including reverse rotation of the pump.
- 6. Impeller:
 - a. Statically and dynamically balanced.
 - b. Impeller Type: Enclosed
 - c. The impellers shall be securely locked on the impeller shaft with stainless steel collets or keys, as recommended by the pump manufacturer. The impeller clearance shall be adjustable by means of an adjusting nut at the top of the motor.
 - d. Impellers shall be equipped with wearing rings designed to maintain pump efficiency. Wearing rings shall be securely locked in place so that they will not move or loosen during any condition of operation or handling, including reverse rotation of the pump.

F. Variable Speed Drives:

- 1. The pumps shall be capable of being operated by a variable frequency drive. The pump manufacturer shall be responsible for coordinating the collection of data for both the motor and the drive to ensure a complete operational system which limits harmonics and potentially damaging motor over-voltages (spikes) to the levels specified.
- 2. The variable frequency drive manufacturer shall be responsible for providing to the pump/motor manufacturer any data required to ensure that a complete and properly operating system is furnished. A letter

confirming that required data was provided as specified shall be included in the submittal package.

3. All equipment for the load shall be derated as recommended by the motor and drive manufacturer for reduced speed operation with a variable frequency drive.

G. Shop Paint:

1. All iron and steel parts which will be in contact with pumped liquid or submerged after installation, including the inside of the pump column and all exterior surfaces below the sub-baseplate, shall be shop cleaned by blasting in accordance with the coating manufacturer's recommendations and painted with an epoxy coating system. The coating shall have a dry film thickness of at least 10 mils and shall consist of a prime (first) coat and one or more finish coats. At least 1 quart of the finish material shall be furnished with each pump for touchup.
2. All steel surfaces shall be protected by suitable coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed and finished with a high-grade, oil-resistant enamel and alkyd enamel system. Coatings shall be suitable for the environment where the equipment is installed.
3. Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of primer as specified in Section 09 96 00.

H. Pump Schedule:

1. High Service Pumps (Flowserve):

a.	Unit Designation	PMP-02554
b.	Number of Units:	One (1)
d.	Speed:	1780 rpm
e.	Motor Starter/Drive:	VFD
f.	Flow Rate Control:	Via VFD control.
g.	First Operating Point at Full Speed:	4,200 gpm at 210 feet TDH, 82.2% minimum efficiency, maximum 22.6 ft NPSH required

h.	Second Operating Point at Full Speed:	4,800 gpm at 175 feet TDH, [80.0%] minimum efficiency
i.	Approximate Shutoff Head, feet	412
j.	Operating Head Range, feet	160 - 230
k.	Runout Conditions	
	1) Flow (gpm):	5,100
	2) Head (feet):	155
l.	Maximum Number of Bowls	Two (2) Stages
m.	Discharge Size:	Fourteen (14) inch diameter with ANSI 150 lb flange.
n.	Motor Nameplate Horsepower	300 hp
q.	Minimum Can Diameter:	Twenty-four (24) inches. Variable.
r.	Pump Column Length:	See Drawings
s.	Min Shop Test Pressure	1.5 times shut-off head
a.	Unit Designation	PMP-02551, PMP-02552
b.	Number of Units:	Two (2)
d.	Speed:	1,780 rpm
e.	Motor Starter/Drive:	RVSS
f.	Flow Rate Control:	None
g.	First Operating Point at Full Speed:	5,600 gpm at 210 feet TDH, 81.8% minimum efficiency, maximum 31.1 ft NPSH required
h.	Second Operating Point at Full Speed:	6,500 gpm at 175 feet TDH, 80.0% minimum efficiency
i.	Approximate Shutoff Head, feet	419
j.	Operating Head Range, feet	160 - 230
k.	Runout Conditions	
	1) Flow (gpm):	7,400

	2) Head (feet):	130
l.	Maximum Number of Bowls	Two (2) Stages
m.	Discharge Size:	Sixteen (16) inch diameter with ANSI 150 lb flange.
n.	Motor Nameplate Horsepower	400 hp
q.	Minimum Can Diameter:	Twenty-four (24) inches
r.	Pump Column Length:	See Drawings
s.	Min Shop Test Pressure	1.5 times shut-off head

2. High Service Pumps (Fairbanks Nijuis):

a.	Unit Designation	PMP-02554
b.	Number of Units:	One (1)
d.	Speed:	1770 rpm
e.	Motor Starter/Drive:	VFD
f.	Flow Rate Control:	Via VFD control.
g.	First Operating Point at Full Speed:	4,200 gpm at 210 feet TDH, 81.3% minimum efficiency, maximum 29.5 ft NSPH required
h.	Second Operating Point at Full Speed:	4,850 gpm at 182 feet TDH, 79.7% minimum efficiency
i.	Approximate Shutoff Head, feet	339
j.	Operating Head Range, feet	160 - 230
k.	Runout Conditions	
	1) Flow (gpm):	5,750
	2) Head (feet):	120
l.	Maximum Number of Bowls	Two (2) Stages
m.	Discharge Size:	Fourteen (14) inch diameter with ANSI

		150 lb flange.
n.	Motor Nameplate Horsepower	300 hp
q.	Minimum Can Diameter:	Twenty-four (24) inches
r.	Pump Column Length:	See Drawings
s.	Min Shop Test Pressure	1.5 times shut-off head
a.	Unit Designation	PMP-02551, PMP-025522
b.	Number of Units:	Two (2)
d.	Speed:	1750 rpm
e.	Motor Starter/Drive:	RVSS
f.	Flow Rate Control:	None
g.	First Operating Point at Full Speed:	5,600 gpm at 210 feet TDH, 80.3% minimum efficiency, maximum 23.7
h.	Second Operating Point at Full Speed:	6,180 gpm at 193 feet TDH, 70.9% minimum efficiency
i.	Approximate Shutoff Head, feet	340
j.	Operating Head Range, feet	160 - 230
k.	Runout Conditions	
	1) Flow (gpm):	7,500
	2) Head (feet):	125
l.	Maximum Number of Bowls	Two (2) Stages
m.	Discharge Size:	Sixteen (16) inch diameter with ANSI 150 lb flange.
n.	Motor Nameplate Horsepower	400 hp
q.	Minimum Can Diameter:	Twenty-four (24) inches
r.	Pump Column Length:	See Drawings

s.	Min Shop Test Pressure	1.5 times shut-off head
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3. High Service Pumps (National Pump Company):

a.	Unit Designation	PMP4
b.	Number of Units:	One (1)
d.	Speed:	1800 rpm
e.	Motor Starter/Drive:	VFD
f.	Flow Rate Control:	Via VFD Control.
g.	First Operating Point at Full Speed:	4,200 gpm at 210 feet TDH, 82.5% minimum efficiency, maximum 28.5 ft NSPH required
h.	Second Operating Point at Full Speed:	4,500 gpm at 194 feet TDH, 81.7% minimum efficiency
i.	Approximate Shutoff Head, feet	364
j.	Operating Head Range, feet	160 - 230
k.	Runout Conditions	
	1) Flow (gpm):	5,100
	2) Head (feet):	150
l.	Maximum Number of Bowls	Two (2) Stages
m.	Discharge Size:	Fourteen (14) inch diameter with ANSI 150 lb flange.
n.	Motor Nameplate Horsepower	300 hp
q.	Minimum Can Diameter:	Twenty-four (24) inches
r.	Pump Column Length:	See Drawings
s.	Min Shop Test Pressure	1.5 times shut-off head
a.	Unit Designation	PMP-02551, PMP-02552
b.	Number of Units:	Two (2)
d.	Speed:	1800rpm
e.	Motor Starter/Drive:	RVSS

f.	Flow Rate Control:	None
g.	First High Rate Operating Point at Full Speed:	5,600 gpm at 210 feet TDH, 83.1% minimum efficiency, maximum 27.1 ft NSPH required
h.	Second Moderate Rate Operating Point at Full Speed:	6,720 gpm at 177 feet TDH, 82.5% minimum efficiency
i.	Approximate Shutoff Head, feet	344
j.	Operating Head Range, feet	160 - 230
k.	Runout Conditions	
	1) Flow (gpm):	8,200
	2) Head (feet):	100
l.	Maximum Number of Bowls	Two (2) Stages
m.	Discharge Size:	Sixteen (16) inch diameter with ANSI 150 lb flange.
n.	Motor Nameplate Horsepower	400 hp
q.	Minimum Can Diameter:	Twenty-four (24) inches
r.	Pump Column Length:	See Drawings
s.	Min Shop Test Pressure	1.5 times shut-off head

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. Provide services of an experienced, competent, and authorized representative of manufacturer or supplier and equipment to visit site of Work and inspect, check, adjust if necessary, and approve equipment installation in accordance with Section 01 79 00. Provide an 8-hour day for installation of each type of pump.
- B. Assure that equipment supplier's representative is present when equipment is placed in operation.
- C. Verify that equipment supplier's representative revisits job site as often as necessary until all trouble is corrected and equipment installation and operation are satisfactory in the opinion of Engineer.

D. Furnish to Owner, through Engineer, a written report prepared by equipment supplier certifying that equipment:

1. Has been properly installed and lubricated.
2. Is in accurate alignment, free of vibration, and functioning reliably in re-priming and automated self-priming modes.
3. Is free from an undue stress imposed by connecting piping or anchor bolts.
4. Has been operated under full load conditions and that it operated satisfactorily.

3.02 INSTALLATION

A. Vertical Turbine Pumps:

1. Concrete base: Provide a concrete base for pump as shown in the Drawings.
2. Sub-base:
 - a. Coordinate size with concrete pump base during installation.
3. Connections, Alignment and Lubrication: Lubricate pump, level, align, and connect pump to motor on steel base. Align and connect pump to suction and discharge piping. Bolt pump and motor to steel base. Bolt steel base to concrete pad mounting location. Perform all steps per manufacturer's recommendations and requirements.
4. Coupling of pump shaft to motor shaft and setting of impellers shall be completed by a qualified representative of the pump manufacturer or supplier.
5. Electrical Connections: Prior to applying electrical power to motor or controls verify that motor and control data plate and site voltage are compatible; verify that all wiring connections are tight; verify that protective devices, fuses, and circuit breakers conform to Specifications and are functional; and verify line voltage, phase sequence and ground before actual start-up.

3.03 FIELD TESTS

A. Operation Testing:

1. After initial startup under the supervision of qualified representative of the pump manufacturer, a preliminary running-in period will be provided for the Contractor to make field tests and necessary adjustments.
2. Demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable, safe, and conforms to specified operating conditions and is operating at optimum condition.

3. Notify Engineer of intent to perform testing a minimum of 48 hours prior to test.

B. Vertical Turbine Pump Vibration Testing:

1. Each vertical turbine pump shall be tested after installation for acceptable vibration levels.
 - a. Field vibration acceptance testing shall be conducted to ensure that the equipment meets the vibration limits specified in the American National Standards for Vertical Pumps for Nomenclature, Definitions, Application and Operation by the Hydraulic Institute. An independent testing laboratory retained by the Contractor and approved by the Engineer shall conduct the vibration acceptance testing. The testing laboratory shall provide a certified vibration analysis specialist to conduct the testing and shall submit certification credentials. Vibration testing shall be performed on each pumping unit after the equipment has been installed, grouted, aligned, and inspected and certified by the manufacturer's field service representative as being ready for continuous service. The Contractor shall provide written notification to Owner, Engineer, and equipment manufacturer's field service representative when each item of equipment subject to vibration acceptance testing is ready for testing. Owner, Engineer, and manufacturer's field service representative shall reserve the right to be present during the tests.
 - b. A resonance bump test shall be performed after the equipment is installed to determine the resonant frequencies of the installed unit. A coast-down and a startup test shall be performed on the coupled equipment to determine machine critical speeds and resonance zones.
 - c. With the exception of the resonance bump test and the startup test, vibration tests shall be performed after the equipment has run loaded for at least 60 minutes and has reached a stable operating temperature.
 - d. Each pumping unit shall be tested separately, without duplicate equipment running.
 - e. Tests shall be conducted under various loading conditions as determined by the Engineer.
 - f. A bump test will be performed on each pump/motor assembly to identify its natural frequency in the field. The VFD's shall be programmed to skip this frequency during normal operations to prevent premature system deterioration.
 - g. Rotating equipment shall be tested for vibration in the field after installation by the following method. Equipment, complete with drive systems in place at the job Site, shall not vibrate more than the values allowed within the American National Standards for Vertical Pumps for Nomenclature, Definitions, Application and Operation by the Hydraulic Institute. All field tests shall be running tests, with the equipment operating on the product for which it is

intended. The term displacement as used herein, shall mean total peak-to-peak movement of vibrating equipment, in mils; velocity or speed of the vibration cycle, measured in inches per second; and acceleration measured in G's. Vibration shall be measured by suitable equipment equal to IRD Mechanalysis, Schenk Trebel, or Bentley Nevada with hard copy printout capabilities. A vibration probe appropriate for the application shall be used. The data shall be collected in the three major planes and shall be measured in units of velocity (inches per second).

- h. The frequency range shall include high frequency data from 0-6000 Hz, high-resolution data from 0-200 Hz, standard motor resolution data from 0-65X run speed, and standard pump resolution data from 30X run speed. Report shall summarize findings and recommended solution. If system requires balancing, this shall be completed and they system re-tested after balancing.
- i. Frequency of vibration in cycles per minute (cpm), shall be determined when vibration exceeds specified levels or as otherwise necessary. Vibration shall be measured on the bearing housing of the pump and motor, unless measurements at other locations are deemed necessary by the vibration analyst and the Engineer.
- j. The Contractor shall submit a vibration test report following each test. The test report shall include a summary of the vibration readings in all three planes. Paper printouts shall be submitted. Resonance bump test results, startup and coast-down results, and uncoupled motor vibration test results, if performed, shall be included. The Engineer shall be furnished with four certified copies of vibration test data for each test performed.
- k. Coupled Vibration shall be checked in the radial and axial directions. Coupled vibration shall not exceed the limits specified within the American National Standards for Vertical Pumps for Nomenclature, Definitions, Application and Operation by the Hydraulic Institute.
- l. Uncoupled motor vibration tests need not be performed unless the coupled equipment does not meet the specified vibration limit and excessive motor vibration is suspected. Uncoupled motor vibration shall not exceed the following limits:
 - 1) Overall vibration limit, in./sec 0.05
 - 2) At rated speed, in./sec. 0.04
 - 3) At twice rated speed, in/sec. 0.02
 - 4) At any harmonic speed, in./sec. 0.02
- m. All rotating assemblies shall be statically and dynamically balanced. The dynamic balance data must be certified and results submitted to the Engineer.
- n. Critical speeds of all rotating equipment shall meet the requirements specified within the American National Standards for

Vertical Pumps for Nomenclature, Definitions, Application and Operation by the Hydraulic Institute.

- o. The Contractor shall be responsible for unit and system assembly vibration testing and their results, which shall be within the specified limits. Copies of test results shall be submitted to the Engineer for review. Should the vibration field test results exceed shop test results or the limits specified, the Contractor shall correct the deficiencies within 30 days. After corrections have been completed, the vibration testing shall be repeated and the results resubmitted to the Engineer for review. Corrections shall continue to be made and tests repeated until satisfactory operation is demonstrated and vibration meets specified limits.
- p. Noise and vibration in any rotating equipment, which the Engineer judges to be excessive or damaging, shall be cause for rejection.
- q. An additional monitoring event and report shall be provided near the end of the warranty period. The second analysis will compare the initial baseline data against the second measurements. If significant growth or change is present in the results, and the data indicates that any system components are wearing at a faster rate than the specified bearing lives, then the bearing(s) shall be replace prior to termination of the warranty.

C. Pump Tests:

- 1. During five (5) consecutive pump cycles observe, record, and submit to Engineer:
 - a. Discharge pressure gauge readings.
 - b. Suction pressure gauge readings.
 - c. Flow rates
 - d. Pump speed if driven by variable frequency drive.
 - e. Ampere draw.
 - f. Function of pump control indicators, lights, etc.
 - g. Calibration of all instrumentation equipment.
 - h. Manual control devices and automatic control systems tests.
 - i. Observations of noise, vibration, or other operational problems.

3.04 DISINFECTION

- A. Disinfect vertical turbine pump equipment in accordance with Section 46 05 10 - Disinfection of Water Systems.

3.05 DEMONSTRATION

A. Operator Training

- 1. Manufacturer's representative to provide a minimum of four (4) hours on site training for plant operations staff.

END OF SECTION

DIVISION 46 WATER AND WASTEWATER EQUIPMENT

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SECTION 46 05 10
DISINFECTION OF WATER SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Disinfection of potable water process and distribution piping.
2. Disinfection of basin systems.
3. Testing and reporting results.

B. Related Sections include:

1. Section 01 31 13 – Project Coordination
2. Section 01 31 19 – Project Meetings
3. Section 01 33 00 – Submittal Procedures
4. Section 01 45 00 – Quality Control
5. Section 01 61 00 – Common Product Requirements
6. Section 01 75 00 – Starting and Adjusting
7. Section 01 77 00 – Closeout Procedures
8. Section 03 30 00 – Cast-In-Place Concrete
9. Section 22 11 16 - Domestic Water Piping
10. Section 33 13 00 – Disinfection of Water Distribution
11. Section 40 05 17 - Copper Piping
12. Section 40 05 24 - Steel Process Pipe
13. Section 40 05 58 - Process Valves
14. Section 40 71 00 - Process Meters
15. Section 43 21 13 - Vertical Turbine Pumps

1.02 REFERENCES

A. Reference Standards:

1. AWWA B300 - Standard for Hypochlorites.
2. AWWA B301 - Standard for Liquid Chlorine.
3. AWWA C651 - Standards for Disinfecting Water Mains.
4. AWWA C652 - Standards for Disinfection of Water Storage Facilities.
5. AWWA C653 – Standards for Disinfection of Water Treatment Plants.
6. Federal Specifications BB-C-12a, O-C-114a, and O-S-602b.
7. *Standard Methods for the Examination of Water and Wastewater*, latest edition.

1.03 DEFINITIONS

- A. Disinfectant Residual means the quantity of disinfectant in treated water.
- B. PPM or ppm means parts per million.

1.04 SUBMITTALS FOR INFORMATION

- A. Section 01 33 00 – Submittal Procedures.
- B. Test Reports: Submit results to Engineer and Owner indicating comparison to specified requirements.

1.05 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 33 00 - Submittal Procedures and Section 01 77 00 - Closeout Procedures.
- B. Disinfection report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- C. Bacteriological report:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.
 - 3. Name of person collecting samples.
 - 4. Test locations.
 - 5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
 - 6. Coliform bacteria test results for each outlet tested.

1.06 QUALITY ASSURANCE

- A. Regulatory Agency Requirements: Comply with Utah DEQ Division of Drinking Water requirements.
- B. Perform Work in accordance with AWWA C651 for the disinfection of water mains, AWWA C652 for the disinfection of storage facilities, and AWWA C653 for the disinfection of Water Treatment Plants.

- C. Testing Firm: Company specializing in testing potable water systems, approved by the Utah DEQ Division of Drinking Water. Contractor shall obtain sampling bottles from an approved laboratory and perform sampling per project requirements and sampling protocol. Contractor shall coordinate sampling and testing schedule with the laboratory. Contractor shall pay all testing fees and lab costs.
- D. Submit bacteriologist's signature and authority associated with testing.
- E. The cleaning and disinfection work shall be conducted prior to connection to the existing water lines or to any portion that has been put into service of new lines installed. Unless otherwise approved, hydrostatic testing shall be completed prior to final cleaning and disinfection.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect against damage and contamination.
- B. Maintain caution labels on hazardous materials.
- C. Maintain storage room dry and with temperatures as uniform as possible between 60 and 80°F.
- D. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

- A. AWWA B300, Hypochlorite: Shall conform to Federal Specification O-C-114a, Type II, Grade B, or Federal Specification O-C-602b.
- B. AWWA B301, Liquid Chlorine: Shall conform to Federal Specification BB-C-120a.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Do not start Work until conditions are satisfactory.
- C. Perform disinfecting activity prior to start-up. Coordinate with other Contractors, Engineer, and Owner.

- D. Flush mains thoroughly before introduction of chlorinating material. Maintain flushing velocity in main of not less than 2.5 feet per second unless the Engineer determines that conditions do not permit the required flow to be discharged to waste.
- E. All scaffolding, planks, tools, rags, and other materials not part of the structural or operating facilities of the tank shall be removed.
- F. Thoroughly clean the surface of the walls, floor, and operating facilities of basins using a high-pressure water jet, sweeping, scrubbing, or equally effective means. All water, dirt, and foreign material accumulated from the cleaning operation shall be removed or discharged from the basins.
- G. Vent screens, overflow screens, and any other screened opening shall be checked and put in satisfactory condition to prevent birds, insects, and other possible contaminants from entering clearwells or other basins.
- H. Minimize the introduction of dirt or other foreign material into the basins after the cleaning procedure has been completed.

3.02 DISINFECTION OF POTABLE WATER PROCESS AND DISTRIBUTION PIPING

- A. Piping, Valves, and Fittings to be Disinfected Include:
 - 1. High service pumps and associated piping.
 - 2. All site piping and connections (Section 33 13 00 - Disinfection of Water Distribution).
 - 3. Water Storage Tank.
- B. Provide and attach required equipment to perform the Work of this Section. Disinfectant material shall be introduced into the water system in a manner approved by the Engineer.
- C. Inject treatment disinfectant into piping system to obtain 50 to 80 ppm residual.
- D. As chlorinated water flows past fittings and valves, related valves shall be operated so as to disinfect appurtenances and pipe branches.
- E. Maintain disinfectant in system for 24 hours. If disinfectant residual is less than 25 ppm, repeat system treatment.
- F. Flush, circulate, and clean until the chlorine residual is lowered to approximately 1.0 ppm; use system water supply
- G. Dispose of heavily chlorinated water properly and according to local, State, and Federal regulations in an environmentally acceptable manner in accordance with AWWA C651.

3.03 DISINFECTION OF BASIN SYSTEMS

- A. Basins to be Disinfected Include:
 - 1. Water Storage Tank.
- B. Provide and attach required tools, equipment, and materials to perform the Work of this Section.
- C. A solution of 50 ppm available chlorine shall be sprayed on all walls and operating facilities. The water and chlorine solution shall fill approximately 5 percent of the total volume of the basins.
- D. Hold the 50 ppm solution in the basins for a period of not less than 6 hours.
- E. Fill water shall be added to the 50 ppm solution to such a depth that the resulting solution shall be 2 ppm.
- F. The resulting 2 ppm solution shall be left standing for 24 hours.
- G. Subject to satisfactory bacteriological testing and acceptable quality, the remaining water may be reintroduced into the system as process water.

3.04 FIELD QUALITY CONTROL

- A. Section 01 45 00 - Quality Control.
- B. Samples for bacteriological analysis shall be collected in sterile bottles obtained from the testing laboratory and submitted for testing.
- C. Samples shall be taken from a sample tap on the outlet piping from the basins. In either case, the operation shall be such as to ensure that the sample collected is actually from water that has been in the basin.
- D. Two or more successive test samples at least 24 hours apart indicating bacteriological satisfactory water shall be obtained before facility and/or piping system is to be placed into operation. Tests shall be in accordance with the latest edition of *Standard Methods for the Examination of Water and Wastewater*.
- E. If initial disinfection fails to produce satisfactory bacteriological results, the water system piping may be re-flushed and shall be re-sampled. If check samples also fail to produce acceptable results, the piping shall be rechlorinated until satisfactory results are obtained.
- F. All disinfection, sampling, and testing costs shall be paid by Contractor.
 - 1. Owner offers testing services Monday through Thursday during business hours. Contractor must coordinate with Owner testing times.

- G. Water mains and appurtenances must be completely installed, flushed, hydrostatically pressure tested, disinfected, and satisfactory bacteriological test results obtained prior to permanent connections are made to the active distribution system. Sanitary construction practices must be followed during installation of the final connection so that there is no contamination of the new or existing water main.

END OF SECTION