CLACKAMAS
WATER
ENVIRONMENT
SERVICES

Gregory L. Geist
Director

March 31, 2022

Board of County Commissioners
Clackamas County

Members of the Board:

Approval of a Contract #5298 with R.L. Reimers Co. for the Kellogg Creek Water Resource Recovery Facility Influent Pumps 2 and 4 Replacement Construction Project. Fiscal Impact is $1,466,125.00 through WES Capital Improvement funds.
No County General Funds are involved. - *Procurement*

Purpose/Outcomes	Approval of a Contract #5298 with R.L. Reimers Co. for the Kellogg Creek Water Resource Recovery Facility Influent Pumps 2 and 4 Replacement Construction Project. Fiscal Impact is $1,466,125.00 through WES Capital Improvement funds. No County General Funds are involved.
Dollar Amount and Fiscal Impact	The contract amount is $1,466,125.00.
Funding Source	WES Capital Funds: 639-70-7002-700203-70020100-48100-WESV-700221305-00. No County General Funds are involved.
Duration	The contract duration is 395 days to final completion following execution and issuance of a Notice to Proceed.
Previous Board Action	Adoption of FY 20-25 Capital Improvement Plan. Award of a contract for engineering design services to Stantec Consulting Services on 2/2/2021. This item was presented at Issues on March 29, 2022.
Strategic Plan Alignment	1. This project supports the County's Strategic Plan of building a strong infrastructure that delivers services to customers and honors, utilizes, promotes and invests in our natural resources. 2. This project supports the WES Strategic Plan goal to provide properly functioning infrastructure that supports healthy streams and reduces flooding.
Counsel Review	This contract was reviewed and approved by Amanda Keller, County Counsel, on 3/21/2022.
Procurement Review	Was this item reviewed by Procurement? Yes
Contact Person	Steven Rice, Senior Civil Engineer, 971-284-3710
Agreement No.	*#5298*

BACKGROUND
WES has completed engineering design and bidding of the Kellogg Creek Water Resource Recovery Facility (KC WRRF) Influent Pumps 2 and 4 Replacement Project. The KC WRRF was constructed as a conventional secondary treatment facility in 1976. The facility recently underwent an improvements project that included, in part, replacement of Influent Pumps 1 and 3, which serve as low flow pumps. Influent Pump 2 (installed in 1976) and Influent Pump 4 (installed in 1996) serve as high flow pumps during periods of wet weather flow. The pumps have exceeded

their expected operating life and are due for replacement. The project was identified in the adopted FY 20-25 Capital Improvement Plan.

This Agreement is for construction of the project and includes replacement of the pumps, motors and associated variable frequency drives, new concrete pump bases, addition of hydraulic straightening vanes, and related piping modifications.

PROCUREMENT PROCESS
This project was advertised in accordance with ORS and LCRB Rules on December 7, 2021. A mandatory pre-bid conference was held at the WRRF site on December 15, 2021. Bids were opened on January 20, 2022. The District received four (4) bids: Fackler Construction, McClure and Sons, Stellar J, and R.L. Reimers. The apparent low bidder was R.L. Reimers, and subsequent review confirmed acceptability of the bid. A notice of intent to award the contract to R.L. Reimers was posted January 24, 2022.

RECOMMENDATION
Staff recommends that the Board of County Commissioners of Clackamas County, acting as the governing body of Water Environment Services, approve and execute the Contract between Water Environment Services and R.L. Reimers, Co. for the KC WRRF Influent Pumps 2 and 4 Replacement Project.

Respectfully submitted,

Lynne Chicoine
Lynne Chicoine (Mar 22, 2022 12:16 PDT)

Lynne Chicoine
WES Capital Manager

Attachments: Contract #5298

PROCURMENT

CLACKAMAS
WATER ENVIRONMENT SERVICES

RECORDING MEMO

☑ New Agreement/Contract

☐ Amendment/Change/Extension

☐ Other: _____

Originating County Department:	Water Environment Services
Purchasing for:	Kellogg Creek Influent Pumps 2 and 4 Replacement
Other party to contract/agreement:	R.L. Reimers Co.

Title from Business Meeting Agenda: Approval of a Contract #5298 with R.L. Reimers Co. for the Kellogg Creek Water Resource Recovery Facility Influent Pumps 2 and 4 Replacement Construction Project. Fiscal Impact is $1,466,125.00 through WES Capital Improvement funds. No County General Funds are involved.

After recording please return to:

Water Environment Services
c/o Lauren Haney, Administrative Services
150 Beavercreek Road, Suite 430
Oregon City, OR 97045

Clerk to the Board please complete below this line after Board approval

Board Agenda Date: _____

Agenda Item Number: _____

WATER ENVIRONMENT SERVICES
AGREEMENT BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION

This Agreement is entered into by and between Water Environment Services ("Owner"), an intergovernmental entity formed pursuant to Oregon Revised Statutes Chapter 190, and **R.L. Reimers Company** ("Contractor").

Terms used in this Agreement have the meanings stated in the General Conditions and the Supplementary Conditions, both identified more specifically in Article 7 below. All references to General Conditions implicitly include a reference to any modifications made by the Supplementary Conditions to the same paragraph.

Owner and Contractor hereby agree as follows:

ARTICLE 1—WORK

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

Replacement of Influent Pumps No. 2 and 4, their associated variable frequency drives, and associated mechanical and electrical improvements.

ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows:

Kellogg Creek Water Resource Recovery Facility Influent Pump 2 and 4 Replacement

ARTICLE 3—ENGINEER

3.01 The Owner has retained Stantec Consulting Services, Inc. ("Engineer") to act as Owner's representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

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

ARTICLE 4—CONTRACT TIMES

4.01 *Time is of the Essence*

A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.

4.03 *Contract Times: Days*

A. The Work will be substantially complete within 365 days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 395 days after the date when the Contract Times commence to run.

4.04 *Milestones*

A. Parts of the Work must be substantially completed on or before the following Milestone(s):

1. Milestone 1:

Submit Pump and VFD Equipment Submittals – 30 days after the date when the Contract Times commence to run, as provided in Paragraph 4.01 of the General Conditions.

4.05 *Liquidated Damages*

A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed and Milestones not achieved within the Contract Times, as duly modified. The parties also recognize the delays, expense, and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):

1. *Substantial Completion:* Contractor shall pay Owner $1,400 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.

2. *Completion of Remaining Work:* After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner $1,400 for each day that expires after such time until the Work is completed and ready for final payment.

3. *Milestones:* Contractor shall pay Owner $1,400 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified above for achievement of each Milestone, until each Milestone is achieved, or until the time specified for Substantial Completion is reached, at which time the rate indicated in Paragraph 4.05.A.1 will apply, rather than the Milestone rate.

4.06 *National Pollutant Discharge Elimination System Permit Violations*

A. Kellogg Creek WRRF must continuously be in compliance with its National Pollutant Discharge Elimination System (NPDES) permit requirements. In the event permit violations are caused or, in the Owner's opinion, will be caused by the Contractor's operations, the Owner shall immediately be entitled to employ others to stop the violations without giving written notice to the Contractor.

B. Penalties imposed on and costs incurred by the Owner as a result of any violations caused by the actions of the Contractor, his employees, or subcontractors, shall be borne in full by the Contractor, including legal fees and other expenses to the Owner resulting directly or indirectly from the violation. Under the terms of discharge permits issued to the Owner, the Owner is liable for the following penalties:

NPDES Permit No. 100983	$ 10,000 per day for each violation

C. The Owner may withhold from any payments owed to the Contractor the amount of such costs, and a Change Order shall be issued to reflect any such reduction.

ARTICLE 5—CONTRACT PRICE

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

A. For all Work other than Unit Price Work, a lump sum of $1,298,600.00 ("Lump Sum Amount"). All specific cash allowances are included in this price in accordance with Paragraph 13.02 of the General Conditions.

B. For all Unit Price Work, an amount equal to the sum of the extended prices (established for each separately identified item of Unit Price Work by multiplying the unit price times the actual quantity of that item).

Unit Price Work					
Item No.	Description	Unit	Estimated Quantity	Unit Price	Extended Price
1	Additive cost to dispose of transformer containing PCBs	Ea	1	$ 9,800.00	$ 9,800.00
2	Temporary Bypass Pumping System	Month	3	$ 52,575.00	$ 157,725.00
Total of all Extended Prices for Unit Price Work (subject to final adjustment based on actual quantities)					$ 167,525.00

The extended prices for Unit Price Work set forth as of the Effective Date of the Contract are based on estimated quantities. As provided in Paragraph 13.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classifications are to be made by Engineer.

C. Total of Lump Sum Amount and Unit Price Work (subject to final Unit Price adjustment) $1,466,125.00 ("Contract Price").

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

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

6.02 *Progress Payments; Retainage*

A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about 30 days following receipt of an Application for Payment during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.

    a. Ninety-five (95) percent of the value of the Work completed (with the balance being retainage). Retainage will be held in an interest-bearing escrow account. Interest on the retainage amount accrues from the date the payment request is approved until the date the retainage is paid to the Contractor.

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

C. In lieu of retainage, Contractor, with the approval of Owner, may deposit a surety bond for all or any portion of the retainage in a form acceptable to Owner. Such bond and any proceeds therefrom shall be made subject to all claims and liens as provided for in ORS 279C.550 to 279C.620.

6.03 *Final Payment*

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

6.04 *Consent of Surety*

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

ARTICLE 7 – CONTRACT DOCUMENTS

7.01 *Contents*

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

1. This Agreement.

2. Supplementary Conditions, attached hereto and incorporated herein as Exhibit A.

3. General Conditions, attached hereto and incorporated herein as Exhibit B. The General Conditions that are made a part of this Contract are EJCDC® C 700, Standard General Conditions for the Construction Contract (2018), published by the Engineers Joint Contract Documents Committee ("General Conditions"), and Owner has plainly shown all modifications to the standard wording of such published document to the Contractor in the Supplementary Conditions.

5. Specifications as listed in the table of contents of the project manual (attached hereto and incorporated as Exhibit C) consisting of 336 pages bearing the title: Kellogg Creek Water Resource Recovery Facility Influent Pump 2 and 4 Replacement Project 100% Submittal - Specifications.

6. Drawings (attached hereto and incorporated as Exhibit D consisting of 33 sheets with each sheet bearing the following general title: Kellogg Creek Water Resource Recovery Facility Influent Pump 2 and 4 Replacement.
8. Addenda numbers 1 to 4, inclusive (not attached but incorporated by reference).
9. Bonds attached hereto and incorporated as Exhibit E:
    a. Performance bond (together with power of attorney).
    b. Payment bond (together with power of attorney).
10. Prevailing Wage Rates (not attached but incorporated by reference).
11. Payroll and Certified Statement Form (not attached but incorporated by reference).
12. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
    a. Notice to Proceed.
    b. Work Change Directives.
    c. Change Orders.
    d. Field Orders.
    e. Warranty Bond, if any.

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

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

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

ARTICLE 7—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 *Contractor's Representations*

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

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

5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.

6. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

8. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

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

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

11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

12. Contractor represents and warrants to Owner that (A) Contractor has the power and authority to enter into and perform this Contract; (B) this Contract, when executed and delivered, shall be a valid and binding obligation of Contractor enforceable in accordance with its terms; (C) Contractor shall at all times during the term of this Contract, be qualified, professionally competent, and duly licensed to perform the Work; (D) Contractor is an independent contractor as defined in ORS 670.600; and (E) the Work under this Contract shall be performed in a good and workmanlike manner and in accordance with the highest professional standards. The warranties set forth in this section are in addition to, and not in lieu of, any other warranties provided.

13. Contractor represents and warrants that it has complied, and will continue to comply throughout the duration of this Contract and any extensions, with all tax laws of this state or any political subdivision of this state, including but not limited to ORS 305.620 and ORS chapters 316, 317, and 318. Any violation of this section shall constitute a material breach of this Contract and shall entitle Owner to terminate this Contract, to pursue and recover any and all damages that arise from the breach and the termination of this Contract, and to pursue any or all of the remedies available under this Contract or applicable law.

8.02 *Contractor's Certifications*

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

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

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

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

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

B. Contractor shall furnish proof of required insurance in accordance with Paragraph 6.02 of the General Conditions and Supplemental General Conditions. Insurance certificates may be returned with the signed Agreement or may be emailed to Procurement@clackamas.us.

8.03 *Miscellaneous Terms*

A. Change Order Authorization. Throughout the performance of the Work under this Agreement, the Owner's Designated Representative (identified on the signature page) is hereby granted the authority to verbally authorize change orders in the field for an amount up to $10,000. As soon as possible following the authorization, the Owner's Designated Representative shall complete the change order form provided by Clackamas County Procurement ("Procurement"), obtain the signature of Owner's Director or other authorized signatory, and submit the form to Procurement for processing. As soon as the Director signs off on the change order form, the Designated Representative may then authorize another change order in the future for up to $10,000 following the same procedure above. Each change order should include the cumulative cost of the entire change and may not be artificially broken up into multiple change orders to fall under the dollar threshold listed above. The authority granted to the Designated Representative is limited by the Director's authorization to amend the Agreement under Clackamas County's Local Contract Review Board Rules and is subject to the discretion of the Director, who may suspend or restrict the Designated Representative's ability to authorize change orders at any time for any reason.

B. Counterparts. This Contract may be executed in several counterparts, all of which when taken together shall constitute an agreement binding on all Parties, notwithstanding that all Parties are not signatories to the same counterpart. Each copy of the Contract so executed shall constitute an original.

C. Required Provisions. All provisions of state law required to be part of this Contract, whether listed in the General Conditions or Supplementary Conditions or otherwise, are hereby

integrated and adopted herein. Contractor acknowledges the obligations thereunder and that failure to comply with such terms is a material breach of this Contract.

D. Integration. The Contract Documents constitute the entire agreement between the parties. There are no other understandings, agreements or representations, oral or written, not specified herein regarding this Contract. Contractor, by the signature below of its authorized representative, hereby acknowledges that it has read this Contract, understands it, and agrees to be bound by its terms and conditions.

[Signature Page Follows]

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

This Agreement will be effective on the last date of signature by the parties below (which is the Effective Date of the Contract).

Owner:

Water Environment Services

By: _____
(individual's signature)

Date: _____
(date signed)

Name: Tootie Smith
(typed or printed)

Title: Chair
(typed or printed)

Address for giving notices:

ATTN: Gregory Geist

150 Beavercreek Road #430

Oregon City, OR 97045

Designated Representative:

Name: Gregory L. Geist
(typed or printed)

Title: Director
(typed or printed)

Address:

150 Beavercreek Road #430

Oregon City, OR 97045

Phone: 503-742-4567

Email: GGeist@clackamas.us

Contractor:

R.L. Reimers Company
(typed or printed name of organization)

By: _____
(individual's signature)

Date: 3/16/2022
(date signed)

Name: Ronald Reimers
(typed or printed)

Title: President
(typed or printed)

Address for giving notices:

3939 old Salem Rd, #200

Albany, OR 97321

Designated Representative:

Name: Ross Meyer
(typed or printed)

Title: Project Manager
(typed or printed)

Address:

3939 old Salem Rd, #200

Albany, OR 97321

Phone: 971-304-5661

Email: ross@rlreimers.com

License No.: 60891
(where applicable)

State: Oregon

EXHIBIT A

Supplementary Conditions

SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract as indicated below. The General Conditions remain in full force and effect except as amended or supplemented.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof. As used in the Contract Documents, masculine pronouns refer to both masculine and feminine genders.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added.

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

SC-1.01 Delete and replace the following subsections in Paragraph 1.01.A:

5. *Bidder*: Any individual, partnership, corporation, joint venture, or other legal entity who submits a Bid to Owner for the Work contemplated and meets the standards set forth in Oregon Revised Statutes 279B.110.

16. *Contractor*: Person or entity identified as such in the Agreement and the Contractor's authorized representatives who are referred to throughout the Contract Documents as if singular in number.

22. *Engineer*: Person or entity identified as such in the Agreement and the Engineer's authorized representatives who are referred to throughout the Contract Documents as if singular in number.

30. *Owner*: The individual, entity, public body or authority identified as such in the Agreement and the Owner's authorized representatives who are referred to throughout the Contract Documents as if singular in number.

SC-1.01 Revise Paragraph 1.01.A.33 by replacing the word "Engineer" with "Owner" and adding the sentence "Synonymous with Construction Manager." to the end of the paragraph.

SC-1.01 Add the following language at the end of 1.01.A.42:

Substantial Completion is further defined as (i) that degree of completion of the Project's operating facilities or systems sufficient to provide Owner the full time, uninterrupted, and continuous beneficial operation of the Work; (ii) all required functional, performance, and acceptance or startup testing has been successfully demonstrated for all components, devices, equipment, and instrumentation and control to the satisfaction of Engineer in accordance with the requirements of the Specifications; (iii) all inspections required have been completed and identified critical defective Work has been replaced or corrected; and (iv) all appurtenant operations and maintenance features (i.e., hose bibs, drainage systems,

etc.) have been installed and are functional. See Paragraph SC-15.03.A for additional requirements.

SC-1.01 Add the following language to the end of the sentence in Paragraph 1.01.A.44:

"as further identified in the Agreement."

SC-1.01 Add new paragraphs immediately following Paragraph 1.01.A.50:

51. *Latent Defect*: A defect in the Work of which the Owner has no knowledge.

52. *Specialist*: The term Specialist refers to a person, partnership, firm, or corporation of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing of fabricated items required by the Contract Documents, or otherwise performing Work required by the Contract Documents. Where the Specifications require the installation by a Specialist, that term shall also be deemed to mean either the manufacturer of the items, a person, partnership, firm, or corporation licensed by the manufacturer, or a person, partnership, firm, or corporation who will perform the Work under the manufacturer's direct supervision.

53. *Construction Manager*: Person or entity designated by the Owner to provide construction management services for the Project with duties, responsibilities, and limitations of the Engineer, unless stipulated otherwise. Synonymous with and having same meaning as Resident Project Representative.

54. *Equipment*:

    a) Construction: All machinery and equipment, together with the necessary supplies for upkeep and maintenance, including tools and apparatus necessary for the proper construction and acceptable completion of the Work contemplated.

    b) Installation: All material or articles used in equipping a facility or apparatus required to fulfill a functional design.

55. *Geotechnical Data Report ("GDR")*: The factual report that collects and presents data regarding actual subsurface conditions at or adjacent to the Site, including Technical Data and other geotechnical data, prepared by or for Owner. The GDR's content may include logs of borings, trenches, and other site investigations, recorded measurements of subsurface water levels, the results of field and laboratory testing, and descriptions of the investigative and testing programs. The GDR does not include an interpretation of the data. If opinions, or interpretive or speculative non-factual comments or statements appear in a document that is labeled a GDR, such opinions,

comments, or statements are not operative parts of the GDR and do not have contractual standing. Subject to that exception, the GDR is a Contract Document.

56. ORS: Oregon Revised Statutes.

57. OAR: Oregon Administrative Rules.

58. Float: The number of days an activity can be delayed beyond its scheduled completion without delaying a succeeding or related activity or restricting the schedule of a preceding activity in the construction schedule.

ARTICLE 2—PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

SC-2.01 Delete Paragraphs 2.01.B. and C. in their entirety and insert the following in their place:

B. *Evidence of Contractor's Insurance:* When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

C. *Public Works Bond:* Before starting any work on the Project, Contractor and every Subcontractor performing work on the Project must have a public works bond filed with the Oregon Construction Contractors Board, as required by ORS 279C.830 and 279C.836, unless exempt under those provisions. Contractor must require that the Subcontractor have a public works bond filed with the Construction Contractors Board before starting work on the Project unless exempt under ORS 279C.836. Contractor shall include copies of both its public works bond and the public works bonds from its Subcontractors in the copies of the bonds required in Paragraph 2.01.A above. See SC-6.01.A for additional requirements related to the public works bond.

2.02 *Copies of Documents*

SC-2.02 Delete the first sentence of Paragraph 2.02.A in its entirety and replace with the following::

If requested, Owner shall furnish to Contractor up to four copies of the conformed Contract Documents (Specifications and half size Drawings and two copies of full-size Drawings) incorporating and integrating all Addenda and any amendments negotiated prior to the Effective Date of the Contract (including one fully executed counterpart of the Agreement) and one copy in electronic portable document format (PDF).

2.03 *Before Starting Construction*

SC-2.03 Add new paragraph immediately following Paragraph 2.03.A.3:

4. a preliminary schedule of payments showing projected cash flow.

SC-2.03 Add new paragraphs immediately following Paragraph 2.03.A:

B. Before any Work at the Site is started, Contractor shall prepare and submit a written plan for the Project-specific safety precautions and programs. The safety plan shall identify Contractor's process for ensuring that safety is the highest priority on the Project and will be

complete with respect to procedures and actions that Contractor intends for Contractor and all others as provided in Paragraphs 7.13 and as required by all applicable Laws and Regulations. The submittal shall include a statement that the Contractor is solely responsible for safety on the Project, that it will conduct its operations in accordance with all applicable safety standards and requirements, and that it will continually review its operations to ensure that safe conditions are provided at all times. Contractor's plan for safety precautions and programs shall have been approved and endorsed by Contractor's designated safety representative required in Paragraph 7.13.B. Delivery of this plan will in no way reduce or obviate Contractor's obligation to comply with the safety obligations set forth in Section 7.13 of the General Conditions.

C. *Contractor Drug Testing Program*: Before any Work at the site is started, Contractor shall provide evidence that it has an employee drug testing program in place that is administered and enforced by the Contractor in accordance with ORS 279C.505.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

SC-2.04 Add the following to the end of Paragraph 2.04.A:

The preconstruction conference will be scheduled by Contractor within five (5) days of the Notice to Proceed or as otherwise agreed to by the parties.

2.05 *Acceptance of Schedules*

SC-2.05 Add the following to the end of Paragraph 2.05.A:

5. Contractor's schedule of payments will be acceptable if it provides a reasonable projection of payments in relationship to the Progress Schedule and Schedule of Values.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

SC 3.01 Add the following to the end of Paragraph 3.01.A:

However, in the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following descending order of precedence:

1. Permits from outside agencies;
2. The Agreement including exhibits, and addenda and any amendments thereto, with those of later date having precedence over those of an earlier date;
3. Supplementary General Conditions;
4. Standard General Conditions of the Construction Contract, Engineers Joint Contract Documents Committee (EJCDC) 2018;
5. Specifications – Division 01;
6. Specifications – Divisions 02 - 49;
7. Drawings;
8. Design Details: Figure dimensions, and dimensions that can be computed, on plans shall take precedence over scale dimensions. The Drawings with the higher level of detail take precedence over less detailed Drawings.

Change Orders, Work Change Directives, Field Orders, Engineer's written interpretation and clarifications and Notice to Proceed, in precedence listed, will take precedence over all other Contract Document components referenced herein.

SC 3.01 Add the following paragraph immediately after Paragraph 3.01.G:

H. Sections of Division 01, General Requirements, govern the execution of the Work of all sections of the Specifications.

3.03 *Reporting and Resolving Discrepancies*

SC 3.03 Delete Paragraph 3.03.B.1 in its entirety and replace with the following:

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and the provision of any standard specification, manual, reference standard, or code,

or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document).

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

SC 4.01 Delete the third sentence of Paragraph 4.01.A in its entirety.

4.04 *Progress Schedule*

SC 4.04 Add the following subparagraph immediately after Paragraph 4.04.A.2:

3. If, in the opinion of Engineer, Contractor falls behind the accepted Construction Schedule due to actions or neglect of Contractor or Contractor's agents, servants, employees, officers, Subcontractors, directors, or any party contracting to perform part or all of the Work or to supply any equipment or materials, Contractor shall take steps, including, but not limited to, increasing the number of personnel, shifts, and/or overtime operations, days of work, and/or amount of construction equipment until such time as the Work is back on schedule. Contractor shall also submit for review no later than the time of submittal of the next request for partial payment, such supplementary schedule or schedules as may be necessary to demonstrate the manner in which the acceptable rate of progress will be regained, all without additional cost to Owner.

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

5.01 *Availability of Lands*

SC 5.01 Delete Paragraph 5.01.B in its entirety.

SC 5.01 Add the following paragraph immediately after Paragraph 5.01.c:

D. Any work performed in public rights-of-way, in addition to conforming to the Contract Documents, shall be done in accordance with the requirements of the permit issued by the public agency in whose right-of-way the Work is located.

5.02 *Use of Site and Other Areas*

SC 5.02 Delete subparagraph 5.02.A.2 in its entirety and replace with the following:

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.13, or otherwise; (b) promptly attempt to settle the claims as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify Owner, Clackamas County and their officers, elected officials, directors, employees, agents, consultants, and subcontractors from and against any such claim, and against all costs, losses and damages arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against

Owner or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

5.03 *Subsurface and Physical Conditions*

SC-5.03 Add the following new paragraphs immediately after Paragraph 5.03.D:

E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

Report Title	Date of Report	Technical Data
None known to Owner		

F. The following table lists the drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data, and specifically identifies the Technical Data upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
Kellogg Creek Water Pollution Control Plant (Original Plant Construction); CH2MHill	1974	None known to Owner
Kellogg Creek WRRF Improvements (Select Drawings); Brown and Caldwell	2018	None known to Owner

G. Documents referenced in SC-5.03. Can be found at the following link:

https://dn.clackamas.us/?linkid=KZi4zr6VWWXOqFHw45YMn6TwEd2gv98t8IDODS6ncAGbVD1eeNa//w

Contractor may request copies from Engineer of reports and drawings identified in SC-5.03.E and SC-5.03.F that were not included with the Bidding Documents.

5.06 *Hazardous Environmental Conditions*

SC-5.06 Add the following new paragraphs immediately after Paragraph 5.06.A.3:

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely:

Report Title	Date of Report	Technical Data
None known to Owner		

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
None known to Owner		

SC-5.06 Delete Paragraph 5.06.I and 506.J in their entirety and replace with the following:

I. Subject to the limitations of the Oregon Constitution and the Oregon Tort Claims Act, Owner shall indemnify Contractor, and its officers, employees, and agents from and against all claims, costs losses and damages arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work; and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I obligates Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify Owner and Clackamas County and their officers, elected officials, directors, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J obligates Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

SC-6.01 Add the following paragraphs immediately after Paragraph 6.01.C:

The Contractor will submit the performance bond and payment bond on forms provided by the Owner.

SC-6.01 Delete Paragraph 6.01.B in its entirety and replace with the following:

B. Before starting any work on the Project, the Contractor shall file with the Oregon Construction Contractors Board, and maintain in full force and effect, the separate public works bond required by Oregon Revised Statutes, Chapter 279C.830 and 279C.836, unless otherwise exempt under those provisions. The Contractor shall also include in every subcontract a provision requiring the Subcontractor to have a public works bond filed with the Construction Contractors Board before starting Work, unless otherwise exempt, and shall verify that the Subcontractor has filed a public works bond before permitting any Subcontractor to start Work. Contractor shall include copies of both its public works bond

and the public works bonds from its Subcontractors in the copies of the bonds required in Paragraph 2.01.A above.

These bonds shall remain in effect until one year after date of Final Completion of the Project and acceptance by the Owner, except as provided otherwise by Laws or Regulations or by the Contract Documents.

SC-6.01 Add the following phrase to Paragraph 6.01.C after the word "Treasury":

or otherwise acceptable to Owner.

SC-6.01 Add the following sentence to the end of Paragraph 6.01.C:

The performance bond shall include, in part, provisions to indemnify Owner, and its officers, directors, elected officials, agents, and employees.

6.02 *Insurance—General Provisions*

SC-6.02 Delete paragraph 6.02.B. in its entirety and replace with the following:

B. As evidence of the insurance coverage required by the Contract, the Contractor shall furnish certificate(s) of insurance to the Owner prior to execution of the Agreement. The certificate(s) will specify all of the parties who are additional insureds or loss payees for the Agreement, identified in SC-6.02.C. A renewal certificate shall be sent to Owner at least 10 days prior to coverage expiration.

Insurance coverage required under the Agreement shall be obtained from insurance companies or entities acceptable to the Owner and that are eligible to provide such insurance under Oregon law. Eligible insurers include admitted insurers that have been issued a certificate of authority from the Oregon Department of Consumer and Business Services authorizing them to conduct an insurance business and issue policies of insurance in the state of Oregon, and certain non-admitted surplus lines insurers that satisfy the requirements of applicable Oregon law and which are subject to approval by the Owner. All companies that provide policies required under this Contract shall have a rating of not less than A-X in the most current edition of Best's Rating Guide, in addition to any other requirements specified herein. The Contractor shall be financially responsible for all deductibles, self-insured retentions and/or self-insurance included hereunder. Any deductible, self-insured retention and/or self-insurance in excess of $50,000 shall be subject to approval by the Owner in writing and shall be a condition precedent to the effectiveness of any Contract.

SC-6.02 Add the following to the end of Paragraph 6.02.D:

The general liability insurance coverage, automobile liability, umbrella, and pollution liability if required, shall include the Owner (Water Environment Services), Clackamas County and Engineer (Stantec Consulting Services, Inc.) as additional insureds, but only with respect to the Contractor's activities to be performed under the Contract Documents. The additional-insured endorsement for CGL insurance must be written on ISO Form CG 20 10 (10 01) and CG 20 37 (10 01), or their equivalent, but shall not use either of the following forms: CG 20 10 (10 93) or CG 20 10 (03 94). Proof of insurance must include a copy of the

endorsement showing "Water Environment Services and Clackamas County, together with their elected officials, agents, officers, and employees" as scheduled insureds.

If Contractor cannot obtain an insurer to name the Owner and Engineer as additional insureds, Contractor shall obtain at Contractor's expense, and keep in effect during the term of the Contract, Owners and Contractors Protective Liability Insurance, naming the Owner and Engineer as additional insureds with not less than a $4,000,000 limit per occurrence. This policy must be kept in effect for 36 months following Final Completion. As evidence of coverage, Contractor shall furnish the actual policy to Owner prior to execution of the Agreement.

SC-6.02 Delete all language in Paragraphs 6.02.E, I, and K and replace each with the word "Reserved."

SC-6.02 Delete from Paragraph 6.02.N "10 days" and replace with "60 days"

SC-6.02 Add the following new paragraphs in order after Paragraph 6.02.N.

O. Compliance. Failure of the Contractor to fully comply with these requirements will be considered a material breach of Contract and shall be cause for immediate termination of the Contract at the option of Owner.

P. If the Contractor receives a non-renewal or cancellation notice from an insurance carrier affording coverage required herein, or receives notice that coverage no longer complies with the insurance requirements herein, Contractor agrees to notify Owner within five (5) business days with a copy of the non-renewal or cancellation notice, or written specifics as to which coverage is no longer in compliance. When notified by Owner, the Contractor agrees to stop Work pursuant to the Contract at Contractor's expense, unless all required insurance remain in effect. Any failure to comply with the reporting provisions of this section, except for the potential exhaustion of aggregate limits, shall not affect the coverages provided to the Owner and its institutions, divisions, officers, and employees. Owner shall have the right, but not the obligation, of prohibiting Contractor from entering the Project Site until a new certificate(s) of insurance is provided to Owner evidencing the replacement coverage. The Contractor agrees that Owner reserves the right to withhold payment to Contractor until evidence of reinstated or replacement coverage is provided to Owner.

Q. Upon Owner's approval, Contractor may obtain worker's compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the project is located, (b) is certified or authorized as a worker's compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker's compensation insurance for similar projects by the state within the last 12 months.

R. All insurance carried by Contractor under the Agreement shall be the primary coverage. The coverages indicated are minimums unless otherwise specified in the Contract Documents.

6.03 *Contractor's Insurance*

SC-6.03 Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.C:

D. *Other Additional Insureds:* As a supplement to the provisions of Paragraph 6.03.C of the General Conditions, the commercial general liability, automobile liability, umbrella or excess,

pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following: **[Here list by legal name (not category, role, or classification) other persons or entities to be included as additional insureds. See GC-6.03.C.]**

E. *Workers' Compensation and Employer's Liability:* The Contractor is an independent contractor for purposes of the Oregon Workers' Compensation Law, as set forth in ORS Chapter 656 ("Workers' Comp Law") and is solely liable for any Workers' Compensation coverage under this Agreement. All employers, including Contractor, that employ subject workers who work under the Agreement in the State of Oregon shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. This shall include Employer's Liability Insurance with coverage limits of not less than $500,000 per accident for bodily injury or disease. Contractor shall ensure that each of its Subcontractors complies with these requirements. The Contractor shall require proof of such Workers' Compensation coverage by receiving and keeping on file a certificate of insurance from each Subcontractor or anyone else directly employed by either the Contractor or its Subcontractors. The Contractor will be solely responsible for payment of any local, state or federal taxes required as a result of these Contract Documents.

Workers' Compensation and Related Policies	**Policy limits of not less than:**
Workers' Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory
Employer's Liability	
Each accident	$500,000

These Contract Documents are not intended to entitle the Contractor to any benefits generally granted to the District, officers, commissioners, agents or employees. Without limitation, but by way of illustration, the benefits not intended to be extended to the Contractor are vacation, holiday and sick leave, other leaves with pay, tenure, medical and dental coverage, life and disability insurance, overtime pay, Social Security, workers' compensation, unemployment compensation, or retirement benefits (except so far as benefits are required by law if the Contractor is presently a member of the Public Employees Retirement System).

F. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:

1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
2. damages insured by reasonably available personal injury liability coverage, and
3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage.
    a. Such insurance must be maintained for three years after final payment.
    b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
4. Underground, explosion, and collapse coverage.
5. Personal injury coverage.
6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of "insured contract" (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
2. Any exclusion for water intrusion or water damage.
3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
4. Any exclusion of coverage relating to earth subsidence or movement.
5. Any exclusion for the insured's vicarious liability, strict liability, or statutory liability (other than worker's compensation).
6. Any limitation or exclusion based on the nature of Contractor's work.
7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	$ 5,000,000
Products—Completed Operations Aggregate	$ 2,000,000
Personal and Advertising Injury	$ 1,000,000
Bodily Injury and Property Damage—Each Occurrence	$ 4,000,000

J. *Automobile Liability:* Contractor shall obtain, at Contractor's expense, and keep in effect during the term of the Agreement, Automobile Liability Insurance covering owned, and/or hired vehicles, as applicable. The coverage may be written in combination with the Commercial General Liability Insurance. Contractor and its Subcontractors shall be responsible for ensuring that all non-owned vehicles maintain adequate Automobile Liability insurance while on Project Site. The Owner may adjust the Automobile Liability insurance amounts required under this provision at any time based upon institution specific risk assessments through the issuance of an amendment to the Agreement.

Automobile Liability	Policy limits of not less than:
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	$ 2,000,000

Automobile Liability	Policy limits of not less than:
Bodily Injury	
Each Person	$
Each Accident	$
Property Damage	
Each Accident	$
[or]	
Combined Single Limit	
Combined Single Limit (Bodily Injury and Property Damage)	$

K. *Umbrella or Excess Liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the Paragraphs above. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

Excess or Umbrella Liability	Policy limits of not less than:
Each Occurrence	$ 10,000,000
General Aggregate	$ 10,000,000

L. *Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements:* Contractor may meet the policy limits specified for employer's liability,

commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy's policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified herein. If such umbrella or excess liability policy was required under this Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of $3,000,000 after accounting for partial attribution of its limits to underlying policies, as allowed above.

M. *Contractor's Pollution Liability Insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage, including cleanup costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance must be maintained for no less than three years after final completion.

Contractor's Pollution Liability	**Policy limits of not less than:**
Each Occurrence/Claim	$ 5,000,000
General Aggregate	$ 10,000,000

N. *Contractor's Professional Liability Insurance:* If Contractor will provide or furnish professional services under this *Contract*, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Contractor's Professional Liability	**Policy limits of not less than:**
Each Claim	$ 1,000,000
Annual Aggregate	$ 5,000,000

6.04 *Builder's Risk and Other Property Insurance*

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:

F. *Builder's Risk Requirements:* The builder's risk insurance must:

1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).

a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.

b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to Owner and Contractor.

2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

3. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of contractors, engineers, and architects).

4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier). If this coverage is subject to a sublimit, such sublimit will be a minimum of $100,000.

5. extend to cover damage or loss to insured property while in transit. If this coverage is subject to a sublimit, such sublimit will be a minimum of $100,000.

6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.

7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.

8. include performance/hot testing and start-up, if applicable.

9. include as named insureds the Owner, Contractor, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds."

SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:

G. *Coverage for Completion Delays:* The builder's risk policy will include, for the benefit of Owner, loss of revenue and soft cost coverage for losses arising from delays in completion that result from covered physical losses or damage. Such coverage will include, without limitation, fixed expenses and debt service for a minimum of 12 months with a maximum deductible of 30 days, plus engineering or other consultants' fees, if not otherwise covered.

H. *Builder's Risk and Other Property Insurance Deductibles:* The purchaser of any required builder's risk, installation floater, or other property insurance will be responsible for costs not covered because of the application of a policy deductible.

1. The builder's risk policy (or if applicable the installation floater) will be subject to a deductible amount of no more than $50,000 for direct physical loss in any one occurrence, except the earthquake and flood deductible, which shall not exceed 2 percent of each loss or $50,000, whichever is greater.

I. A loss insured under the Builder's Risk insurance shall be made payable to the Owner as loss payee. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-Subcontractors in similar manner. The Owner shall have power to work directly with and settle a loss with insurers.

6.05 *Property Losses; Subrogation*

SC-6.05 Delete all language in Paragraphs 6.05.B and C and replace each with the word "Reserved."

6.06 *Receipt and Application of Property Insurance Proceeds*

SC-6.06 Delete Paragraph 6.06.A, B and C in their entirety and replace with the following paragraph:

A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.04 will be adjusted and settled with the named insured that purchased the policy.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.02 *Supervision and Superintendence*

SC-7.02 Add the following immediately after the first sentence of Paragraph 7.02.B:

If a replacement is necessary, the replacement shall also be a competent resident superintendent and shall be subject to prior approval by Owner. The Contractor's superintendent shall be present at the Site at all times while Work is in progress and shall be available by phone for emergencies 24 hours per day, 7 days per week. If at any time the superintendent leaves the Project Site while Work is in progress, Owner and Engineer shall be notified and provided with the name of the Contractor's representative having responsible charge. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

7.03 *Labor; Working Hours*

SC-7.03 Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be between 7:00 a.m. and 6:00 p.m. on weekdays, Monday through Friday, only. If change to these standard hours is desired, a written request must be placed with Owner and Engineer a minimum of five work days prior to the first day of altered hours.

2. Owner's legal holidays are:

- New Year's Day (January 1)
- Martin Luther King Jr. Day (third Monday in January)
- President's Day (third Monday in February)
- Memorial Day (last Monday in May)
- Juneteenth National Independence Day (June 19)
- Independence Day (July 4)
- Labor Day (first Monday in September)
- Veteran's Day (November 11)
- Thanksgiving Day (fourth Thursday in November)
- Christmas Day (December 25)

7.04 *Services, Materials, and Equipment*

SC-7.04 Add the following paragraphs immediately after Paragraph 7.04.C:

D. Until Substantial Completion of the Work is acknowledged by Owner, Contractor shall have the responsible charge and care of the Work and of materials to be used herein, including materials for which Contractor has received partial payment or materials which have been furnished by Owner, and shall bear the risk of injury, loss, or damage to any part thereof by the action of the elements or from any other cause, whether arising from the execution of the Work or not.

E. Contractor shall rebuild, repair, restore, and make good all injuries, losses, or damages to any portion of the Work or the materials occasioned by any cause before the Work's completion and acceptance and shall bear the expense thereof. Where necessary to protect the Work or materials from damage, Contractor shall, at Contractor's own expense, provide suitable drainage and erect such temporary structures or rent such structures as are necessary to protect the Work or materials from damage. The suspension of the Work or the granting of an extension of time for any cause whatever shall not relieve Contractor of Contractor's responsibility for the Work and materials as specified herein.

F. When the quality of a material, process, or article is not specifically set forth in the Contract Documents, the best available quality of the material, process, or article shall be provided.

7.06 *Substitutes*

SC-7.06 Amend Paragraph 7.06.B by deleting the third sentence stating "Engineer will be the sole judge of acceptability."

7.07 *Concerning Subcontractors and Suppliers*

SC-7.07 Add the following language directly following the last sentence of Paragraph 7.06.A:

Contractor shall perform with Contractor's own organization Work amounting to not less than 25 percent of the combined value of all items of the Work covered by the Contract.

SC-7.07 Add the following new paragraphs immediately after Paragraph 7.07.M:

N. Contractor shall ensure that any person entering into any subcontract to perform under the Contract is registered with the Secretary of State to do business in the State of Oregon, not prohibited from entering into a public contract by the Oregon Bureau of Labor and Industry,

the Oregon Construction Contractors Board or Federal Excluded Party listings and is a Responsible Proposer as defined by ORS 279C.

O. Subcontractor Insurance: Unless a special type of insurance or special amount of coverage is required by the Owner for a specific subcontract or type of work, Contractor shall require all Subcontractors to provide and maintain insurance coverages with at least $1,000,000/claim, $2,000,000 aggregate for commercial general liability, $500,000/claim for automobile liability, $1,000,000/claim for professional liability (if applicable), and statutory limits for workers' compensation insurance. Contractor shall require certificates of insurance from all Subcontractors as evidence of coverage. Contractor shall provide copies of Subcontractor's certificates of insurance, if requested by Owner. This condition may be met through utilization of a Contractor Controlled Insurance Program.

7.08 *Patent Fees and Royalties*

SC-7.08 Delete Paragraph 7.08.B and .C in their entirety and replace with the following:

B. Subject to the limits of the Oregon Constitution, Owner shall indemnify Contractor, and its officers, employees, agents from and against all claims, costs, losses, and damages arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify Owner, Clackamas County and their officers, directors, elected officials, employees, agents, consultants and subcontractors of from and against all claims, costs, losses, and damages arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 *Permits*

SC-7.09 Add the following new paragraph immediately after Paragraph 7.09.A:

B. Contractor will be responsible for obtaining all required permits and maintaining compliance with those permits throughout the course of the Work. Owner will pay the cost of obtaining all permits. The Contractor shall be responsible for any penalties or fines that result from Contractor's noncompliance with the terms of the permits.

7.11 *Laws and Regulations*

SC-7.11 Delete Paragraph 7.11.B in its entirety and replace with the following:

B. If Contractor performs any Work or takes any other action knowing or having reason to know that is contrary to Laws and Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify Owner, Clackamas County, and their officers, directors, elected officials, employees, agents, consultants and subcontractors from and against all claims, costs, losses and damages arising out of or relating to such Work or other action. It is not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in

accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.

SC-7.11 Add the following new paragraph immediately after Paragraph 7.11.C:

D. While not intended to be inclusive of all Laws or Regulations for which Contractor may be responsible under Paragraph 7.10, the following Laws or Regulations, as may be amended from time to time, are included as mandated by statute or for the convenience of Contractor:

1. Prevailing Wage Rates:

a. Contractor shall comply fully with the provisions of ORS 279C.800 through 279C.870. Pursuant to ORS 279C.830(1)(d), Contractor shall pay workers not less than the specified minimum hourly rate of wage, and shall include that requirements in all subcontracts.

PREVAILING WAGE RATES for Public Works Contracts in Oregon, July 1, 2021 which can be downloaded at the following web address:

http://www.oregon.gov/boli/whd/pwr/pages/pwr_state.aspx

b. Owner will pay the Commissioner of the Bureau of Labor and Industries the fee required by ORS 279C.825.

c. Contractor shall provide written notice to all workers of the number of hours per day and days per week such workers may be required to work.

2. Discrimination: Contractor shall comply with all applicable requirements of federal and state civil rights and rehabilitation statutes, rules and regulations, and:

a. In accordance with ORS 279A.110, Contractor will not discriminate against Disadvantaged, Minority, Women, or Emerging Small Business enterprises, as those terms are defined in ORS 200.005, or a business enterprise that is owned or controlled by or that employs a disabled veteran, as that term is defined in ORS 408.225, in obtaining required subcontracts.

b. Contractor shall maintain, in current and valid form, all licenses and certificates required by the applicable Laws, Regulations or the Contract when performing the work.

3. In accordance with ORS 279C.505, Contractor shall demonstrate to Owner that it has an employee drug testing program is in place prior to commencement and at all times during the performance of the Work.

4. ORS 654.150 applies at the Construction Site. All costs incurred in complying with state statutes requiring sanitation facilities shall be borne by Contractor.

5. Payment by Contractor:

a. The Contractor shall promptly make full payment for labor, materials, supplies and provisions at such times as they become due and payable to all persons supplying the Contractor or their Subcontractor with labor, services, materials, supplies, or provisions for the prosecution of the Work provided for in the Contract. Contractor shall pay all contributions or amounts due the Industrial Accident Fund from such Contractor or Subcontractor incurred in the performance of the Work. The Contractor shall not permit any lien or claim to be filed or prosecuted against the

Owner for or on account of any labor, services, materials, supplies, or provisions furnished. The Contractor shall pay to the Department of Revenue all sums withheld from employees pursuant to ORS 316.167.

b. In the event the Contractor fails, neglects, or refuses to make prompt and full payment of any claim for labor, services, materials, supplies or provisions furnished by any person in connection with the Work, whether the labor, services, materials, supplies, or provisions to be performed are furnished for the Contractor or for a Subcontractor, then and in such event, the Owner may withhold the amount of such claim by the person or persons furnishing such labor, services, materials, supplies, or provisions and deduct the amount of from funds due or to become due to the Contractor by reason of the Contract Documents. The deduction of any such amounts because of claims and the manner herein authorized will not, however, relieve the Contractor or his surety from their obligation with respect to any unpaid claims. Sums withheld for the purposes named herein will be paid to the Contractor upon certification that said claims have been paid. Notwithstanding the foregoing, Owner, in its discretion, may pay such claims and deduct or charge that amount of the payment against funds due or to become due the Contractor by reason of the Contract Documents.

c. If the Contractor or a first-tier Subcontractor fails, neglects or refuses to make payment to a party furnishing labor or materials in connection with the project within 30 days after receipt of payment from the Owner or Contractor, the Contractor or first-tier Subcontractor shall owe the party the amount due plus interest charges commencing at the end of the ten-day period that payment is due under ORS 279C.580(4) and any upon final payment unless payment is subject to a good-faith dispute as defined in ORS 279C.580. The rate of interest charge to the Contractor or first-tier Subcontractor and the amount due shall equal three times the discount rate on 90-day commercial paper in effect at the Federal Reserve Bank in the Federal Reserve District that includes Oregon on the date that is 30 days after the date when payment was received from the Owner or from the Contractor, but the rate of interest shall not exceed 30 percent. The amount of interest may not be waived. Contractor shall incorporate this provision into all subcontracts.

d. If the Contractor or a Subcontractor fails, neglects or refuses to make payment to a person furnishing labor or materials in connection with the Contract, the person may file a complaint with the Oregon Construction Contractor's Board unless payment is subject to a good-faith dispute as defined in ORS 279C.580. Resolution of such dispute and computation of amounts due plus interest and costs shall be as provided in that statute. Contractor shall incorporate this provision into any subcontract related to this project.

e. The payment of a claim in the manner authorized under this section shall not relieve the Contractor or the surety from any obligation with respect to any unpaid claims.

f. Contractor shall pay Subcontractor for satisfactory performance within ten days out of such amounts paid to Contractor by Owner, and shall at all times comply with ORS 279C.580, which is incorporated herein by reference.

g. The Contractor shall include in each subcontract for property or services entered into by the Contractor and a first-tier Subcontractor, including a materials supplier,

for the purpose of performing a construction contract, a payment clause that obligates the Contractor to pay the first-tier Subcontractor for satisfactory performance under its subcontract within ten (10) days out of such amounts as are paid to the Contractor by the Owner under such Contractor.

h. All employers, including Contractor, that employ subject workers who work under the Contract Documents in the State of Oregon shall comply with ORS 656.017 and provide the required Workers Compensation coverage, unless such employees are exempt under ORS 656.126. Contractor shall ensure that each of its subcontracts complies with these requirements.

i. As a condition to Owner's performance hereunder, Contractor shall promptly, as due, make payment to any person, co-partnership, association or corporation furnishing medical, surgical, and hospital care or other needed care and attention, incident to sickness or injury, to the employees of the Contractor, of all sums of which the Contractor agrees to pay for the services and all moneys and sums that the Contractor collected or deducted from the wages of employees under any law, contract or agreement for the purpose of providing or paying for the services.

6. Payroll Certification and Fee Requirements.

a. In accordance with ORS 279C.845, the Contractor and every Subcontractor shall submit written certified statements to the Owner on the form prescribed by the Commissioner of BOLI, certifying the hourly rate of wage paid each worker which the Contractor or the Subcontractor has employed on the Project and further certifying that no worker employed on the Project has been paid less than the prevailing rate of wage or less than the minimum hourly rate of wage specified in the Contract Documents, which certified and statement shall be verified by the oath of the Contractor or the Subcontractor that the Contractor or Subcontractor knows the contents of the certified statement, and, that to the Contractor's or Subcontractor's best knowledge and belief, the certified statement is true. The certified statements shall set out accurately and completely the payroll costs for the prior week, including the name and address for each worker, the worker's correct classification, rate of pay, daily and weekly number of hours worked, deductions made, and actual wages paid. Certified statements for each week during which the Contractor or Subcontractor has employed a worker on the Project shall be submitted once a month, by the fifth (5th) business day of the following month. The Contractor and Subcontractor shall preserve the certified statements for a period of ten (10) years from the date of completion of the Work.

b. Pursuant to ORS 279C.845(7), the Owner shall retain 25 percent of any amount earned by the Contractor, in addition to other retainage, on the Work until the Contractor has filed the certified statements required above. The Owner shall pay the Contractor the amount retained under this subsection within 14 business days after the Contractor files the required certified statements, regardless of whether a Subcontractor has failed to file certified statements.

c. Pursuant to ORS 279C.845(8), the Contractor shall retain 25 percent of any amount earned by a first-tier Subcontractor on this Project until the Subcontractor has filed with the Owner the certified statements required above. Before paying any amount required under this subsection, the Contractor shall verify that the first-tier

Subcontractor has filed the certified statement. Within 14 days after the first-tier Subcontractor has filed the certified statement, the Contractor shall pay the first-tier Subcontractor any amount retained under this subsection.

7 Subcontracts. Contractor shall include in each first-tier subcontract, and shall require that each first-tier Subcontractor include in each lower-tier subcontract; clauses for payments, interest penalties and conditions as required under ORS 279C.580, which is incorporated herein by reference. Contractor shall certify that it shall not accept a bid from Subcontractors to perform Work unless such Subcontractors are registered with the Construction Contractors Board in accordance with ORS 701.021 at the time they submit their bids to the Contractor.

8. Environmental Pollution:

   a. In compliance with ORS 279C.525, lists of federal, state, and local agencies of which the Owner has knowledge that have enacted ordinances or regulations relating to environmental pollution and the preservation of natural resources that may affect the performance of the Contract are listed in the 2015 Oregon Department of Transportation Standard Specifications for Construction, Section 00170.01.

   b. If Contractor is delayed or must undertake additional work by reason of existing regulation or ordinances of agencies not cited herein, or due to enactment of new or the amendment of existing statutes, ordinances or regulations occurring after the submission of the successful Proposal, Owner may grant a time extension, a reasonable adjustment in the Cost of Work by issuance of a Change Order setting forth the additional work that must be undertaken. Such Change Order, if any, shall not invalidate the Agreement and shall, as applicable, increase the Agreement price to compensate Contractor for all costs and expenses incurred, including overhead and profits, as reasonable compensation of any such delay or additional work.

9. In accordance with ORS 279C.510, Contractor shall salvage or recycle construction and demolition debris if feasible and cost effective.

10. Workers employed by Contractor shall not be able to collect for unpaid overtime unless a claim is filed in accordance with ORS 279C.545 with Contractor.

11. Person claiming not being paid in full for supplied labor or materials for performance of the Work has right to file notice of such claim. Notice shall be filed in accordance with ORS 279C.605.

12. As applicable, Contractor shall comply with Clackamas County Code and Water Environment Services Rules and Regulations.

13. Contractor agrees to comply with the following, as applicable and as may be amended from time to time: i) Title VI and VII of the Civil Rights Act of 1964; ii) Section 503 and 504 of the Rehabilitation Act of 1973; iii) the Health Insurance Portability and Accountability Act of 1996; iv) the Americans with Disabilities Act of 1990; v) ORS Chapter 659A; vi) all regulations and administrative rules established pursuant to any applicable laws; and vii) all other applicable requirements of federal, state, county or other local government entity statutes, rules and regulations.

14. The following notice is applicable to Contractors who perform excavation Work: ATTENTION: Oregon law requires you to follow rules adopted by the Oregon Utility

Notification Center. Those rules are set forth in OAR 952-001-0090. You may obtain copies of the rules by calling the center at (877) 668 4001.

15. Independent Contractor Status: The service or services performed under the Contract Documents are those of an independent contractor as defined in ORS 670.600. Contractor represents and warrants that it is not an officer, employee or agent of the Owner as those terms are used in ORS 30.265.

16. Retirement System Status and Taxes: Contractor represents and warrants that it is not a contributing member of the Public Employees' Retirement System and will be responsible for any federal or state taxes applicable to payment received under the Agreement. Contractor will not be eligible for any benefits from these payments under the Agreement of federal Social Security, employment insurance, workers' compensation or the Public Employees' Retirement System, except as a self-employed individual. Unless Contractor is subject to backup withholding, Owner will not withhold from such payments any amount(s) to cover Contractor's federal or state tax obligations.

17. Government Employment Status: The Contractor represents and warrants that it is not currently employed by the Federal Government. This does not preclude the Contractor from holding another contract with the Federal Government.

19. Failure to comply with any or all of the requirements of Section 7.11.D shall be a material breach of the Contract and constitute grounds for Contract termination. Any and all damages or costs resulting from such noncompliance shall be the responsibility of Contractor.

7.12 *Record Documents*

SC-7.12 Amend Paragraph 7.12.A by adding "and Owner" after the word "Engineer" in the third sentence.

7.13 *Safety and Protection*

SC-7.13 Add the following directly after the last sentence of Paragraph 7.13.E:

Contractor shall be aware that permit-required confined spaces exist in or near the Project Site. Entry to these spaces must be accomplished in compliance with the requirements of OAR 166-150-0190 (29 CFR 1910.146). Examples of permit-required confined spaces include but are not limited to the following:

- Open tanks beyond the handrails including clarifiers, aeration basins, channels, etc.
- Manholes.
- Flow control structures which have the potential to contain sewage.
- Enclosed tanks including digesters, clarifiers, grit basins, chemical tanks, etc.
- Wet well and dry wells of pump stations.
- Headworks channels.
- Electrical vaults.

The hazards associated with these confined spaces may include but are not limited to:

- Oxygen deficiency.

- Combustible vapors including methane.
- Slip hazards.
- Fall/retrieval hazard.
- Engulfment hazard.
- Lockout required of mechanical and electrical devices.
- Toxic or hazardous chemicals including hydrogen sulfide and process chemicals.
- Traffic hazards.
- Hot work and ignition sources.
- Potential for rapid changes in working conditions.
- Painting or coating application activities often pose temporary hazards.

Prior to beginning Work in permit-required confined spaces, Contractor shall provide Owner with a copy of Contractor's permit-required confined space entry plan/program including a copy of the permit forms that will be used by Contractor. Upon request by Contractor, Owner will review with Contractor, Owner's permit-required confined space program and specific procedures Owner would incorporate in spaces entered. Owner will coordinate any of its entries into the same spaces with Contractor. When the permit-required confined space Work is completed, Contractor shall inform Owner, in writing, of any hazards encountered or changes made resulting in different hazards within the space.

SC-7.13 Add the following new paragraphs immediately after Paragraph 7.13.J:

K. Contractor shall revise Contractor's plan for safety precautions and programs at appropriate times to reflect changes in construction conditions, the Work, Contractor's means, methods, techniques, sequences, and procedures of construction. Contractor shall disseminate the original plan and revisions to all others indicated in Paragraphs 7.13.C.1.

L. Contractor's plan for safety precautions and programs will not require more stringent safety requirements, training or other qualifications for all others than Contractor sets forth for comparable activity and responsibility of Contractor, Subcontractors and Suppliers and their respective employees.

7.15 *Emergencies*

SC-7.15 Amend Paragraph 7.15.A by adding the words "and Owner" immediately after the word "Engineer" in the second sentence.

7.17 *Contractor's General Warranty and Guarantee*

SC-7.17 Add the following new paragraph after Paragraph 7.17.D.9:

10. any acceptance by Owner or any failure to do so.

SC-7.17 Add the following new paragraph after Paragraph 7.17.E:

F. Contractor shall warrant the Work to be free of defects in materials and workmanship for a period of one year from the date of Substantial Completion by the Owner. The Contractor shall correct defective Work during the warranty period as described in the General Conditions.

7.18 *Indemnification*

SC-7.18 Delete Paragraph 7.18.A in its entirety and replace with the following:

A. Contractor shall be responsible for all damage to property, injury to persons, and loss, expense, inconvenience, and delay that may be caused by, or result from, the carrying out of the Work to be done under the Contract, or from any act, omission or neglect of the Contractor, its Subcontractors, employees, guests, visitors, invitees and agents.

To the fullest extent permitted by law, Contractor shall indemnify and defend (with counsel approved by Owner) the Owner, Clackamas County, and their elected officials, officers, directors, agents, and employees (collectively "Indemnitees") from and against all liabilities, damages, losses, claims, expenses, demands and actions of any nature whatsoever which arise out of, result from or are related to: (a) any damage, injury, loss, expense, inconvenience or delay; (b) any accident or occurrence which happens or is alleged to have happened in or about the Project Site or any place where the Work is being performed, or in the vicinity of either, at any time prior to the time the Work is fully completed in all respects; (c) any failure of the Contractor to observe or perform any duty or obligation under the Contract Documents which is to be observed or performed by the Contractor, or any breach of any agreement, representation or warranty of the Contractor contained in the Contract Documents or in any subcontract; (d) the negligent acts or omissions of the Contractor, a Subcontractor or anyone directly or indirectly employed by them or any one of them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss or expense is caused in part by a party indemnified hereunder (except to the extent otherwise void under ORS 30.140); and (e) any lien filed upon the Project or bond claim in connection with the Work. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity which would otherwise exist as to a party or person described in this section.

In addition, Contractor shall indemnify the Owner, Clackamas County, and their elected officials, officers, directors, agents, and employees from and against any and all actions, claims, fines, costs or damages incurred by Owner as a result of a violation of the Owner's National Pollutant Discharge Elimination System Permit, where such violations are the result of the Contractor's negligence. The Owner may withhold from any payments owed to the Contractor the amount of such fines, and a Change Order shall be issued to reflect any such reduction.

However, neither Contractor nor any attorney engaged by Contractor shall defend the claim in the name of Owner or Clackamas County ("County"), purport to act as legal representative of Owner or County, nor settle any claim on behalf of Owner or County without the prior approval of the Clackamas County Counsel's Office. Owner or County may assume their own defense and settlement at their election and expense.

SC-7.18 Amend paragraph 7.18.B by removing "or Engineer" from the first sentence.

ARTICLE 8—OTHER WORK AT THE SITE

8.02 *Coordination*

SC-8.02 Add the following new Paragraph 8.02.C immediately after Paragraph 8.02.B:

C. Other work anticipated to be performed at the Site by others that is not related to but coincides with the scheduled performance of the Work under these Contract Documents is described in Section 01 31 13, Project Coordination.

8.03 *Legal Relationships*

SC-8.03 Amend Paragraph 8.03.C by deleting both uses of the word "Engineer" from the first sentence.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.02 *Replacement of Engineer*

SC-9.02 Amend Paragraph 9.02.A by deleting the words "provided Contractor makes no reasonable objection to the replacement engineer."

9.05 *Lands and Easements; Reports, Tests, and Drawings*

SC-9.05 Delete Paragraph 9.05.C in its entirety and replace with the following:

D. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site relating to existing surface or subsurface structures at the Site that have been utilized by Engineer in preparing the Contract Documents.

9.11 *Evidence of Financial Arrangements*

SC-9.11 Delete Paragraph 9.11.A in its entirety and replace with the following:

A. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.03 *Resident Project Representative*

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.B:

C. Resident Project Representative (RPR) will be furnished by the Engineer. The responsibilities, authority, and limitations of the RPR are limited to those of Engineer in accordance with Paragraph 10.08 and as set forth elsewhere in the Contract Documents and are further limited and described below. The RPR will:

1. *Schedules*: Review and monitor Progress Schedule, Schedule of Submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.

2. *Conferences and Meetings:* Conduct or attend meetings with Contractor, such as preconstruction conferences, progress meetings, Work conferences and other Project related meetings.

3. *Liaison*

a. Serve as Engineer's liaison with Contractor, working principally through Contractor's authorized representative, and assist in understanding the intent of the Contract Documents;

b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's onsite operations;

c. Assist in obtaining from Owner additional details or information when required for proper execution of the Work.

4. *Interpretation of Contract Documents*: Inform Engineer and Owner when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor technical clarifications and interpretations as issued by Engineer, or non-technical clarifications and interpretations of the Contract Documents issued by Owner.

5. *Submittals*: Receive submittals that are furnished at the Site by Contractor, and notify Engineer of availability for examination. Advise Engineer and Contractor of the commencement of any Work or arrival of materials and equipment at Site, when recognized, requiring a Shop Drawing or Sample if the submittal has not been approved by Engineer.

6. *Modifications*: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and provide recommendations to Engineer; transmit to Contractor, in writing decisions as issued by Engineer.

7. *Review of Work and Rejection of Defective Work*:

   a. Conduct onsite observations of the Work in progress to assist Engineer in determining if the Work is, in general, proceeding in accordance with the Contract Documents.

   b. Inform Engineer and Contractor whenever RPR believes that any Work is defective.

   c. Advise Engineer whenever RPR believes that any Work will not produce a completed Project that conforms generally to the Contract Documents or will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, whenever RPR believes Work should be uncovered for observation, or requires special testing, inspection, or approval.

   d. Monitor to ensure that tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate personnel, and that Contractor maintains adequate records thereof.

   e. Observe, record and report to Engineer appropriate details relative to the test procedures and startups.

   f. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to the Engineer.

8. *Inspections, Tests, and System Startups*:

   a. Verify tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate personnel, and that Contractor maintains adequate records thereof.

   b. Observe, record, and report to Engineer appropriate details relative to the test procedures and system startups.

c. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections, and report to Engineer.

9. *Records*:

   a. Maintain at the Site files for correspondence, conference records, Submittals including Shop Drawings and Samples, reproductions of original Contract Documents including all Addenda, the signed Agreement, Written Amendments, Work Change Directives, Change Orders, Field Orders, additional Drawings issued after the Effective Date of the Agreement, Engineer's written clarifications and interpretations, progress reports, and other Project related documents.

   b. Keep a record of pertinent Site conditions, activities, decisions and events.

10. *Reports*:

    a. Furnish Engineer periodic reports of progress of the Work and of Contractor's compliance with the Progress Schedule and Schedule of Submittals.

    b. Consult with Engineer in advance of scheduled major tests, inspections or start of important phases of the Work.

    c. Assist in drafting proposed Change Orders, Work Change Directives, and Field Orders, and obtain backup material from Contractor as appropriate.

11. *Payment Requests*: Review Applications for Payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

12. *Certificates, Operation and Maintenance Manuals*: During the course of the Work, verify materials and equipment certificates and operation and maintenance manuals and other data required by Specifications to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and ensure these documents have been delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

13. *Substantial Completion*:

    a. Conduct an inspection in the company of Engineer, Owner, and Contractor and prepare a list of items to be completed or corrected.

    b. Submit to Engineer a list of observed items requiring completion or correction.

14. *Final Completion*:

    a. Conduct final inspection in the company of Engineer, Owner, and Contractor.

    b. Notify Contractor and Engineer in writing of all particulars in which this inspection reveals that the Work is incomplete or defective.

    c. Observe that all items on final list have been completed, corrected, or accepted by Owner and make recommendations to Engineer concerning acceptance.

D. The RPR will not:

1. Have authority to authorize a deviation from Contract Documents or substitution of materials or equipment, unless authorized by Owner.
2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, Suppliers, or or Contractor's authorized representative.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of construction, unless such advice or directions are specifically required by the Contract Documents.
5 Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Owner.
7. Accept shop drawings or samples from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.
9. Take an action that would affect Owner's obligations related to scope or schedule of the Work.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

SC-10.06 Delete the last sentence of Paragraph 10.06.A and replace it with the following:

In rendering such decisions and judgments, Engineer will not show partiality to the Owner or Contractor. If a dispute, matter for interpretation or need for judgment arises that includes allegations against the Engineer, then the Engineer shall not be the party deciding that matter.

10.07 *Limitations on Engineer's Authority and Responsibilities*

SC-10.07 Add the following new paragraph immediately after Paragraph 10.07.E:

F. Only the Owner has the authority to authorize modifications of the Contract Documents, additional Work, or changes the Contract Time or Contract Price.

ARTICLE 11—CHANGES TO THE CONTRACT

11.02 *Change Orders*

SC-11.02 Delete Paragraph 11.02.B in its entirety.

11.07 *Change of Contract Price*

SC-11.07 Amend Paragraph 11.07.C.2.a by replacing "15" with "10".

SC-11.07 Amend Paragraph 11.07.C.2.c by replacing "15" with "10".

SC-11.07 Add the following new paragraph immediately after Paragraph 11.07.C:

E. In the event Contractor submits request for additional compensation as a result of a change or differing Site conditions, or as a result of delays, acceleration, or loss of productivity, Owner reserves right, upon written request, to audit and inspect Contractor's books and records relating to the Project. Upon written request for an audit, Contractor shall make its books and

records available within 14 days of request. Owner shall specifically designate the identity of the auditor. As part of audit, Contractor shall make available its books and records relating to the Project, including, but not limited to, Bidding Documents, cost reports, payroll records, material invoices, subcontracts, purchase orders, daily timesheets, and daily diaries. Audit shall be limited to those cost items that are sought by Contractor in a Change Order or Claim submission to Owner.

11.08 *Change of Contract Times*

SC-11.08 Add the following to Paragraph 11.08.B:

All requests for time extensions shall be supported by Schedule analysis showing the effect on the entire Project taking into account concurrent Work and the critical path, including Float. Partial demonstration of impact on particular operations only will not be acceptable to show the criticality of any event on the Project Schedule as a whole.

SC-11.08 Add the following new paragraphs immediately following Paragraph 11.08.B:

C. *Use of Float*:

1. A claim for an adjustment of Contract Times (or Milestones), otherwise allowable under the Contract Documents, shall be granted only when the time lost or gained exceeds the float for the activity at the time of the event giving rise to the claim. Float is jointly owned by both Owner and Contractor, whether expressly disclosed or implied in any manner.

2. Contractor shall not use Float suppression techniques (including, but not limited to, preferential sequencing caused by late starts of follow-up trades, unreasonably small crews, extended durations, or imposed dates) in information provided to Owner or Engineer.

ARTICLE 12—CLAIMS

12.01 *Claims*

SC-12.01 Delete Paragraph 12.01.A.1 in its entirety and replace with the following:

1. Appeals by the Contractor of Owner's decisions regarding Change Proposals;

SC-12.01 Add the following language to the end of the sentence in Paragraph 12.01.D.3:

"for disputes involving the Owner and Contractor."

ARTICLE 13—COST OF WORK; ALLOWANCES, UNIT PRICE WORK

13.01 *Cost of the Work*

SC-13.01 Amend Paragraph 13.01.B.1 by deleting the third sentence and replacing it with the following language:

Labor costs for employees in the direct employ of Contractor in the performance of the Work will be the actual cost for wages in accordance with the Oregon BOLI Prevailing Wage Rates for Public Works Contracts in Oregon (see SC-7.10.D.1.a for specific BOLI publication) for each craft or type of workers performing the Work at the time the Work is done, plus BOLI's established Fringe Rate for employer payments of payroll taxes, worker compensation

insurance, liability insurance, health and welfare, pension, vacation, apprenticeship funds, and other direct costs resulting from Federal, State or local laws, as well as assessments or benefits required by lawful collective bargaining agreements. Labor costs for equipment operators and helpers will be paid only when such costs are not included in the invoice for equipment rental. The labor costs for foremen and superintendents shall be proportioned to all of their assigned Work and only that applicable to extra Work shall be paid.

SC-13.01 In Paragraph 13.01.B.4, delete the word "special" and replace with the word "technical," and delete the parenthetical phrase "(including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants)" in its entirety.

SC-13.01 Delete Paragraph 13.01.B.5.c in its entirety and replace with the following:

c. Rentals of construction equipment at the rental rate listed for such equipment specified in the current edition of the "Contractor's Equipment Cost Guide" as published by Equipment Watch (www.equipmentwatch.com), telephone number 800/699-3282, or from rate sheets from local rental companies. Such 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 will 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 the equipment not listed by the references specified herein, 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 establishment of the rental rate. Payment shall be subject to the following:

1) Payment for equipment which is already on the Project Site and which is used in the completion of Work will not be allowed;

2) 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;

3) 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;

4) Unless otherwise specified, manufacturer's 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 minimum rating recommended by the manufacturer;

5) Individual pieces of equipment or tools having a replacement value of $400 or less, whether or not consumed by use, will be considered to be small tools and no payment will be made therefore; and

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

The rental time to be paid for equipment at the Site will be the time the equipment is in productive operation on the Work being performed and, in addition, will 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; except, that moving time will not be paid if the equipment is used on other than the Work, even though located at the Site of the 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, except that no payment will be made for loading and transporting costs when the equipment is used at the Site of the Work on other than the Work related to the Change Order, Change proposal, Claim, set-off, or other adjustment in Contract Price. Rental time will not be allowed while equipment is inoperative due to breakdowns. The rental time of equipment on the Work Site will be computed subject to the following:

1) When hourly rates are listed, any part of an hour less than 30 minutes of operation will be considered to be one-half hour of operation, and any part of an hour in excess of 30 minutes will be considered 1 hour of operation;

2) When daily rates are listed, any part of a day less than 4 hours operation will be considered to be half-day of operation. When Owner -operated equipment is used to perform extra Work to be paid from on time and materials basis, the Contractor will be paid for the equipment and operator, as follows;

a) Payment for the equipment will be made in accordance with the provisions in Paragraph 13.01.B.5.c above;

b) Payment for the cost of labor and subsistence or travel allowance will be made at the rates established in Paragraph SC-13.01.B.1; and

c) 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 Section 00 72 00, General Conditions, Paragraph 13.01.D.

SC-13.01 Add the following language to the end of Paragraph 13.01.B.5.h:

Express and courier services must be approved prior to use.

SC-13.01 Supplement Paragraph 13.01.C.2 by adding the following sentence at the end of the existing language:

For purposes of this paragraph, “small tools and hand tools” means any tool or equipment whose current price if it were purchased new at retail would be less than $500.

SC-13.01 Amend Paragraph 13.01.E by deleting the word “three” in the third sentence and replacing it with “ten”.

SC-13.01 Add the following to Paragraph 13.01.E:

Supporting data shall include but not be limited to daily submissions of timesheets indicating hours and trades worked, equipment and time equipment was employed, and materials expended. Also see SC-7.11.D.6.

If for any reason, any part of the Work or the Contract shall be subject to litigation, Contractor shall retain all such records until all litigation is resolved and Contractor shall continue to provide Owner and/or its agents with full access to such records until such time as all litigation is complete and all periods for appeal have expired and full and final satisfaction of any judgment, order or decree is recorded and Owner receives a record copy of documentation from Contractor.

13.03 *Unit Price Work*

SC-13.03 Delete Paragraph 13.03.E in its entirety.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCCEPTANCE OF DEFECTIVE WORK

14.02 *Tests , Inspections, and Approvals*

SC-14.02 Delete Paragraph 14.02.A in its entirety and replace with the following:

A. Contractor shall notify Engineer 48 hours prior to the expected time for operations requiring inspection and laboratory testing services. Contractor shall cooperate with inspection and testing personnel and furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.

SC-14.02 Add the following to the end of Paragraph 14.02.D:

Tests required by Contract Documents to be performed by Contractor that require test certificates be submitted to Owner or Engineer for acceptance shall be made by an independent testing laboratory or agency licensed or certified in accordance with Laws and Regulations and applicable state and local statutes. In the event state license or certification is not required, testing laboratories or agencies shall meet the following applicable requirements:

1. "Recommended Requirements for Independent Laboratory Qualification," published by the American Council of Independent Laboratories.
2. Basic requirements of ASTM E329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction" as applicable.
3. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards or accepted values of natural physical constants.

Prior to requesting a certificate of Substantial Completion, and allowing occupancy of facilities, Contractor shall provide an inspection by a state industrial safety representative, by an independent safety inspector certified by the state in the construction type being inspected, or a federal or state (OSHA) representative qualified in the construction type being inspected, to determine that the facilities provided are in compliance with the state and federal safety requirements. Signed copies of the inspection reports shall be submitted to the Engineer for Owner's files. Violations or deficiencies noted therein shall be resolved prior to occupancy of the facilities and before final payment will be made.

14.03 *Defective Work*

SC 14.03 Add the following language to Paragraph 14.07.C:

If the Owner is unable to use set-offs to recover the total amount owed under this provision, then Owner may use any and all available methods for recovering the remaining amounts from Contractor.

ARTICLE 15—PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD

15.01 *Progress Payments*

SC-15.01 Amend paragraph 15.01.A by adding the following after the last sentence:

The Owner will make progress payments in accordance with ORS 279C.570.

SC-15.01 Add the following subparagraphs after Paragraph 15.01.B.4:

5. Stored Material and Equipment: Payments for stored materials and equipment shall be based only upon the actual cost of the materials and equipment to Contractor and shall not include any overhead or profit to Contractor. Partial payments will not be made for undelivered materials or equipment.

6. Schedule and Data: During the progress of the Work, each Application for payment shall be accompanied by Contractors updated schedule of operations, or progress report, with Shop Drawings schedules, procurement schedules, and value of materials on had included in the application and other data specified in Section 01 33 00, Submittal Procedures, or reasonably required by Engineer.

7. Unless otherwise indicated in the Contract Documents, partial payment for Equipment shall be as follows:

    a) 5 percent upon final approval of Shop Drawings by Engineer or Owner.

    b) 55 percent upon delivery of goods.

    c) 35 percent upon start-up and final acceptance by Engineer or Owner in accordance with Paragraph 15.04.

    d) 5 percent upon delivery of operations and maintenance manuals.

8. Total price for mobilization shall not exceed 1.0 percent of the Contract Price. Total price for demobilization shall not be less than 2.0 percent of the Contract Price.

SC-15.01 Amend Paragraph 15.01.E.1 by adding the following at the end:

m. Any funds retained pursuant to SC-7.11.D.6, SC-7.18 and SC-15.03.B.

SC--15.01 Add the following new paragraph immediately after Paragraph 15.01.E:

F. Subcontractor Payments. Contractor shall make payments to Subcontractors in accordance with SC-7.11.D.

15.03 *Substantial Completion*

SC-15.03. Amend Paragraph 15.03.A by adding the following:

Conditions precedent to Substantial Completion of the Work and Engineer's issuance of a Certificate of Substantial Completion shall include:

a. Conformance with all training services requirements and deliverables.

b. Submittal of current record documents to the Owner and Engineer.

c. Submittals have been received and approved or accepted by Engineer including, but not limited to, the following:

i. Approved Shop Drawings;

ii. Electrical testing and wiring diagram;

iii. Equipment data forms;

iv. Manufacturer's certificates of proper installation;

v. Factory test reports;

vi. Commissioning, testing and startup reports;

vii. Final Operations and Maintenance Manuals;

viii. Extra materials (spare parts) (as specified).

SC-15.03 Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, will be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under this Article 15.

15.06 *Final Payment*

SC-15.06 Add the following new paragraph immediately after Paragraph 15.06.A.2.e:

f. In accordance with ORS 279A.120, when out of state Contractor is awarded a Contract, Contractor is required to report to the Department of Revenue the Contract Price, terms of payment, length of Contract, and other information as Department of Revenue

may require. Owner will verify Contractor has satisfied this requirement prior to issuing final payment.

15.07 *Waiver of Claims*

SC-15.07 Delete Paragraph 15.07.A in its entirety.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

SC-16.01 Amend Paragraph 16.01.A by adding the following language to the end of the third sentence:

"unless the cause for delay is due to the negligence of Contractor or anyone whom Contractor has the responsibility or right to control."

16.02 *Owner May Terminate for Cause*

SC-16.02. Amend Paragraph 16.02.A by adding the following at the end of the sentence:

"in a manner consistent with ORS 279C.670."

16.04 *Contractor May Stop Work or Terminate*

SC-16.04. Delete Paragraph 16.04 in its entirety.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

17.02 *Litigation*

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

17.02 *Litigation*

A. Any Claim between Owner and Contractor that arises from or relates to the Contract and that is not resolved through the Claims Review Process shall be brought and conducted solely and exclusively within the Circuit Court of Clackamas County for the State of Oregon; provided, however, if a Claim must be brought in a federal forum, then it shall be brought and conducted solely and exclusively within the United States District Court for the District of Oregon. In no event shall this section be construed as a waiver by the County of any form of defense or immunity, whether sovereign immunity, governmental immunity, immunity based on the Eleventh Amendment to the Constitution of the United States or otherwise, from any claim or from the jurisdiction of any court. CONTRACTOR, BY EXECUTION OF THE CONTRACT, HEREBY CONSENTS TO THE IN PERSONAM JURISDICTION OF THE COURTS REFERENCED IN THIS SECTION.

ARTICLE 18—MISCELLANEOUS

18.06 *Survival of Obligations*

SC-18.06. Amend Paragraph 18.06.A by adding the following directly after the last sentence:

All warranty and indemnification provisions of the Contract, and all of Contractor's other obligations under the contract that are not fully performed by the time of Final Completion

or termination, shall survive final completion, final acceptance, or any termination of the Contract.

18.07 *Controlling Law*

SC-18.07 Delete Paragraph 18.07.A in its entirety and replace with the following:

A. This Contract is governed by the laws of the State of Oregon without giving effect to the conflict of law provisions thereof.

18.11 *General Provisions*

SC-18.11 Add the following after Paragraph 18.10:

18.11 *General Provisions*

A. No Third Party Beneficiaries: Owner and Contractor are the only parties to the Contract and are the only parties entitled to enforce its terms. Nothing in the Contract gives, is intended to give, or shall be construed to give or provide any benefit or right, whether directly, indirectly, or otherwise, to third persons unless such third persons are individually identified by name herein and expressly described as intended beneficiaries of the terms of the Contract.

B. Severability: If any provision of the Contract is declared by a court to be unenforceable, illegal, or in conflict with any law, the validity of the remaining terms and provisions shall not be affected and the rights and obligations of the parties shall be construed and enforced as if the Contract did not contain the particular provision held to be invalid.

C. Non-Exclusive Rights and Remedies: Except as otherwise expressly provided herein, the rights and remedies expressly afforded under the provisions of the Contract shall not be deemed exclusive, and shall be in addition to and cumulative with any and all rights and remedies otherwise available at law or in equity. The exercise by either Party of any one or more of such remedies shall not preclude the exercise by it, at the same or different times, of any other remedies for the same default or breach, or for any other default or breach, by the other Party.

D. Debt Limitation: The Contract is expressly subject to the debt limitation of Oregon counties set forth in Article XI, Section 10, of the Oregon Constitution, and is contingent upon funds being appropriated therefore. Any provisions herein which would conflict with law are deemed inoperative to that extent.

E. No Attorney Fees: In the event any arbitration, action or proceeding, including any bankruptcy proceeding, is instituted to enforce any term of this Contract, each party shall be responsible for its own attorneys' fees and expenses.

EXHIBIT B

General Conditions

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared By

EJCDC®
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

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

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

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

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

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

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

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

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

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

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

10. *Claim*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

29. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

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

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

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

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

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

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

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

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

38. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands or areas furnished by Owner which are designated for the use of Contractor.

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

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

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

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

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

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

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

46. *Technical Data*

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

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

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

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

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

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

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

1.02 *Terminology*

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

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

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

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

1. does not conform to the Contract Documents;

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

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

E. *Furnish, Install, Perform, Provide*

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

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

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

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

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

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

ARTICLE 2—PRELIMINARY MATTERS

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

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

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

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

2.02 *Copies of Documents*

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

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

2.03 *Before Starting Construction*

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

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

2. a preliminary Schedule of Submittals; and

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

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

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

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

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

2.05 *Acceptance of Schedules*

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

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

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

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

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

2.06 *Electronic Transmittals*

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

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

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

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

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

B. It is the intent of the Contract Documents to describe a functionally complete Project (or part thereof) to be constructed in accordance with the Contract Documents.

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

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

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

F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

G. Nothing in the Contract Documents creates:

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

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

3.02 *Reference Standards*

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

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

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

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

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

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

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

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

B. *Resolving Discrepancies*

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

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

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

3.04 *Requirements of the Contract Documents*

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

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

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

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media versions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

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

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

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

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

4.02 *Starting the Work*

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

4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the

established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

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

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

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

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

4.05 *Delays in Contractor's Progress*

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

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

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

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

2. Abnormal weather conditions;

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

4. Acts of war or terrorism.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

5.01 *Availability of Lands*

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

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

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

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

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

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

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

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

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

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

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

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

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

3. Technical Data contained in such reports and drawings.

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

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

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

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

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

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

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

5.04 *Differing Subsurface or Physical Conditions*

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

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

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

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

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

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

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

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

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

E. *Possible Price and Times Adjustments*

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

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

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

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

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

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

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

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

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

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

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

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

5.05 *Underground Facilities*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

F. *Possible Price and Times Adjustments*

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

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

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

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

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

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

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

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

5.06 *Hazardous Environmental Conditions at Site*

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

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

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

3. Technical Data contained in such reports and drawings.

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

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

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

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

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

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

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

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

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

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

H. If, after receipt of such written notice, Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special

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

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

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

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

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

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

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

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

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

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

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

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

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

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

6.02 *Insurance—General Provisions*

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

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

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

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

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

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

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

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

H. Contractor shall require:

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

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

I. If either party does not purchase or maintain the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

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

K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price will be adjusted accordingly.

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

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

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

6.03 *Contractor's Insurance*

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

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

1. include at least the specific coverages required;

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

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

4. apply with respect to the performance of the Work, whether such performance is by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable; and

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

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

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

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

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

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

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

6.04 *Builder's Risk and Other Property Insurance*

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

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

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

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

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

6.05 *Property Losses; Subrogation*

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

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

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

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

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

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

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

6.06 *Receipt and Application of Property Insurance Proceeds*

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

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

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

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

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

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

7.02 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents.

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

7.03 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall maintain good discipline and order at the Site.

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

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

7.04 *Services, Materials, and Equipment*

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

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

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

7.05 *"Or Equals"*

A. *Contractor's Request; Governing Criteria*: Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of equipment or material, or items from other proposed Suppliers, under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an "or equal" item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that the proposed item:

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

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

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

4) is not objectionable to Owner.

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

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

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

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

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

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

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

7.06 *Substitutes*

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

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

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

3. Contractor shall make written application to Engineer for review of a proposed substitute item of equipment or material that Contractor seeks to furnish or use. The application:

    a. will certify that the proposed substitute item will:

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

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

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

    b. will state:

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

        2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item; and

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

    c. will identify:

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

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

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

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

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

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

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

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

7.07 *Concerning Subcontractors and Suppliers*

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

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

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

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

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

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

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

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

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

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

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

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

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

7.08 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If an invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights will be disclosed in the Contract Documents.

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

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.09 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

7.10 *Taxes*

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

7.11 *Laws and Regulations*

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

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

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

7.12 *Record Documents*

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

7.13 *Safety and Protection*

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

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

C. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

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

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

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

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

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

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

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

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

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

7.14 *Hazard Communication Programs*

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

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

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

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

b. determine and verify:

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

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

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

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

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

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

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

1. *Shop Drawings*

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

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

2. *Samples*

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

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

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

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

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. Engineer's review and approval will be only to determine if the items covered by the Submittals will, after installation or incorporation in the Work, comply with the requirements of the Contract Documents, and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction, or to safety precautions or programs incident thereto.

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

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

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

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

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

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

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

D. *Resubmittal Procedures for Shop Drawings and Samples*

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

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

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

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

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

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

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

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

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

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

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

7.17 *Contractor's General Warranty and Guarantee*

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

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

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

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

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

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

2. normal wear and tear under normal usage.

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

1. Observations by Engineer;

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

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

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

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

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

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

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

9. Any correction of defective Work by Owner.

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

7.18 *Indemnification*

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

B. In any and all claims against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A will not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

7.19 *Delegation of Professional Design Services*

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

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

C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.

D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:

1. Checking for conformance with the requirements of this Paragraph 7.19;

2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and

3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.

F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.

G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.

D. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. The identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. An itemization of the specific matters to be covered by such authority and responsibility; and

3. The extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment will take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site.

1. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this Paragraph 8.03.B.

2. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due Contractor.

C. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents will be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe, as an experienced and qualified design professional, the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.07. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Resident Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in the Supplementary Conditions and in Paragraph 10.07.

B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

10.04 *Engineer's Authority*

A. Engineer has the authority to reject Work in accordance with Article 14.

B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.

C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.

D. Engineer's authority as to changes in the Work is set forth in Article 11.

E. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.05 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.06 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.07 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, will create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation, and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Contractor under Paragraph 15.06.A, will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.07 also apply to the Resident Project Representative, if any.

10.08 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs of which Engineer has been informed.

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.

C. All changes to the Contract that involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

11.02 *Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. Changes in Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. Changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. Changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.05, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters; and

4. Changes that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

11.03 *Work Change Directives*

A. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.07 regarding change of Contract Price.

B. If Owner has issued a Work Change Directive and:

1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.

2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

11.04 *Field Orders*

A. Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly.

B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.05 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.

B. Such changes in the Work may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work must be performed under the applicable conditions of the Contract Documents.

C. Nothing in this Paragraph 11.05 obligates Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.06 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.C.2.

11.07 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

1. Where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03);

2. Where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.07.C.2); or

3. Where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.07.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will be determined as follows:

1. A mutually acceptable fixed fee; or

2. If a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. For costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee will be 15 percent;

b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 percent;

c. Where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of 5 percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted Work the maximum total fee to be paid by Owner will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;

d. No fee will be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

e. The amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in Cost of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and

f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

11.08 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.

B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

11.09 *Change Proposals*

A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.

2. *Supporting Data*: The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal.

    a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.

    b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

    The supporting data must be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.

4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change

Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

C. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

11.10 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12—CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor are subject to the Claims process set forth in this article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents;

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters; and

4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge

and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim will be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate will stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process will resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process will resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action will be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim will be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim will be incorporated in a Change Order or other written document to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13—COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. When needed to determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work will be in amounts no higher than those commonly incurred in the locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, will be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, which will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee will be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed or retained for services specifically related to the Work.

5. Other costs consisting of the following:

a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, which are

consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.

2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.

3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed Work.

d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of builder's risk or other property insurance established in accordance with Paragraph 6.04), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. The cost of purchasing, renting, or furnishing small tools and hand tools.

3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

5. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

6. Expenses incurred in preparing and advancing Claims.

7. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:

a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.

b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:

1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.

2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.

2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change

Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment for any of the foregoing will be valid.

C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor for Work covered by allowances, and the Contract Price will be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision

thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:

a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and

b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.

2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.

3. Adjusted unit prices will apply to all units of that item.

ARTICLE 14—TESTS AND INSPECTIONS; CORRECTION, REMOVAL, OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply with such procedures and programs as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work will be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests will be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering will be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt written notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs,

losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work will be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work,

or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace defective Work as required by Engineer, then Owner may, after 7 days' written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15—PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments for Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

B. *Applications for Payments*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents.

2. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation

establishing full payment by Contractor for the materials and equipment; (b) at Owner's request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

4. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work;

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;

    d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

    e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

    a. Claims have been made against Owner based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

c. Contractor has failed to provide and maintain required bonds or insurance;

d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

f. The Work is defective, requiring correction or replacement;

g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

h. The Contract Price has been reduced by Change Orders;

i. An event has occurred that would constitute a default by Contractor and therefore justify a termination for cause;

j. Liquidated or other damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens; or

l. Other items entitle Owner to a set-off against the amount recommended.

2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed will be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld will be treated as an amount due as determined by Paragraph 15.01.D.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than 7 days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time

submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which will fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have 7 days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without

significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through 15.03.E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.04 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.12), and other documents, Contractor may make application for final payment.

2. The final Application for Payment must be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents;

   b. consent of the surety, if any, to final payment;

   c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.

d. a list of all duly pending Change Proposals and Claims; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Final Application and Recommendation of Payment*: If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Notice of Acceptability*: In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.

D. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment and issuance of notice of the acceptability of the Work.

E. *Final Payment Becomes Due*: Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

15.07 *Waiver of Claims*

A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted as a Claim, or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such adjacent areas;
2. correct such defective Work;
3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, and
4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting from the corrective measures.

B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.

C. If, after receipt of a notice of defect within 60 days and within the correction period, Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.

D. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

E. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times directly attributable to any such suspension. Any Change Proposal seeking such adjustments must be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment, or failure to adhere to the Progress Schedule);

2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) 10 days' written notice that Owner is considering a declaration that Contractor is in default and termination of the Contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) written notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within 7 days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects,

attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate for Convenience*

A. Upon 7 days' written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid for any loss of anticipated profits or revenue, post-termination overhead costs, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon 7 days' written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, 7 days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The

provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full, pursuant to Article 12; and

2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions;

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:

1. in person, by a commercial courier service or otherwise, to the recipient's place of business;

2. by registered or certified mail, postage prepaid, to the recipient's place of business; or

3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision will not constitute a waiver of that provision, nor will it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Assignment of Contract*

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

18.09 *Successors and Assigns*

A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

18.10 *Headings*

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

EXHIBIT C

Specifications

CLACKAMAS

WATER ENVIRONMENT SERVICES

Kellogg Creek Water Resource Recovery Facility

11525 SE McLoughlin Blvd.

Milwaukie OR 97222

100% Submittal – Specifications

Influent Pump 2 and 4 Replacement Project

PROPOSAL / CONSTRUCTION CONTRACT

CONTRACT SPECIFICATIONS

BID # _____

C.I.P. No. _____

SPECIFICATIONS – DIVISION 01 TO 46

END OF TABLE OF CONTENTS

SECTION 01 10 00 - SUMMARY OF WORK

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The WORK to be performed under this Contract shall consist of furnishing plant, tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The WORK shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the WORK in good faith shall be provided by the CONTRACTOR as though originally so indicated, at no increase in cost to the OWNER.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. The WORK of this Contract includes, but is not limited to:

- Demolition of two raw sewage pumps, associated piping and pump pedestals
- Demolition of the two pump variable frequency drives
- Demolition of an old transformer and removal of connected cabling.
    - The base bid shall assume the transformer does not contain Polychlorinated biphenyl (PCBs)
    - The CONTRACTOR shall provide an additive bid item assuming the transformer does contain PCBs and will dispose of the transformer in accordance with the authorities having jurisdiction.
- Installation of two new raw sewage pumps, pump motors, associated piping, and new pump pedestals. The pump and motor assembled weight will exceed the capacity of the bridge crane and shall not be assembled prior to lowering into the pump vault.
- Installation of all electrical gear, control panels, instruments, variable frequency drives, and other miscellaneous piping, HVAC, and demolition work.
- Utilizing the services of Portland Engineering, Inc., for the Instrumentation and Control installation and programming of the work.

B. The WORK is located at the OWNER's Facility at 11525 SE McLoughlin Blvd. Milwaukie, OR 97222.

1.3 CONTRACT METHOD

A. The WORK hereunder will be constructed under a single lump sum contract.

1.4 WORK BY OTHERS

A. Where 2 or more contracts are being performed at one time on the same Site or adjacent land in such manner that work under one contract may interfere with work under another, the OWNER will determine the sequence and order of the Work in either or both contracts. When the Site of one contract is the necessary or convenient means of access for performance of work under another, the OWNER may grant privilege of access or other reasonable privilege to the contractor so desiring, to the extent, amount, and in manner and at time that the OWNER may determine. No OWNER determination of method or time or sequence or order of the work or access privilege shall be the basis for a claim for

delay or damage except under provisions of the General Conditions for temporary suspensions of the work. The CONTRACTOR shall conduct its operations so as to cause a minimum of interference with the work of such other contractors and shall cooperate fully with such contractors to allow continued safe access to their respective portions of the Site, as required to perform work under their respective contracts.

B. Interference With Work On Utilities**:** The CONTRACTOR shall cooperate fully with all utility forces of the OWNER or forces of other public or private agencies engaged in the relocation, altering, or otherwise rearranging of any facilities which interfere with the progress of the WORK, and shall schedule the WORK so as to minimize interference with said relocation, altering, or other rearranging of facilities.

1.5 WORK SEQUENCE

A. The CONTRACTOR's attention is directed to the fact that during the construction period of no interruption in pump station flow can be accommodated, and the CONTRACTOR shall so schedule its construction operations that no interference with the operation of the system shall occur.

B. Access to the site is limited to the hours of 7am to 3pm during Monday to Friday unless otherwise approved by the OWNER.

1.6 CONTRACTOR USE OF SITE

A. The CONTRACTOR's use of the Site shall be limited to its construction operations, including on-Site storage of materials, on-Site fabrication facilities, and field offices.

B. CONTRACTOR may use existing plant roads. All roads must be kept in service and accessible by the OWNER at all times.

1.7 OUTAGE PLAN AND REQUESTS

A. Unless the Contract Documents indicate otherwise, the CONTRACTOR shall not remove from service, de-energize, or modify settings for any existing operating pipeline, valve, pump, channel, equipment, structure, road, or any other facility without permission from the OWNER.

1. If pump demolition or installation occurs at any time during the wet season (Oct 1st to May 31st) the CONTRACTOR shall make provisions for bypass pumping. See Specification 01 50 10.

2. For short term outages necessary to complete the WORK, The maximum duration of any outage shall be 4 hours.

3. The minimum time between short term outages shall be 8 hours.

B. Where the WORK requires modifications to existing facilities or construction of new facilities and connection of new facilities to existing facilities, the CONTRACTOR shall submit a detailed outage plan and schedule for the ENGINEER'S approval a minimum of 2 weeks in advance of the time that such outage is planned.

C. A completed System Outage Request form (template furnished by the OWNER) shall accompany each outage plan. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of the Contract

Documents. The outage plan shall describe the CONTRACTOR's method for preventing bypassing of other treatment units; the length of time required to complete said operation; any necessary temporary power, controls, instrumentation or alarms required to maintain control, monitoring, and alarms for the treatment plant processes; and the manpower, plant, and equipment which the CONTRACTOR will furnish for proper operation of associated treatment units. All costs for preparing and implementing the outage plans shall be at no increase in cost to the OWNER.

D. The ENGINEER shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required.

E. The CONTRACTOR shall provide written confirmation of the shutdown date and time 2 working days prior to the actual shutdown.

1.8 OWNER USE OF THE SITE

A. The OWNER may utilize all or part of the existing facilities during the entire period of construction for conduct of the OWNER's normal operations. The CONTRACTOR shall cooperate and coordinate with the OWNER to facilitate the OWNER's operations and to minimize interference with the CONTRACTOR's operations at the same time. In any event, the OWNER shall be allowed access to the Site during the period of construction.

1.9 PROJECT MEETINGS

A. Preconstruction Conference

1. Prior to the commencement of WORK at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by the CONTRACTOR'S Project Manager, its superintendent, and its subcontractors as the CONTRACTOR deems appropriate. Other attendees will be:

    a. ENGINEER and the Resident Project Representative.

    b. Representatives of OWNER.

    c. Governmental representatives as appropriate.

    d. Others as requested by CONTRACTOR, OWNER, or ENGINEER.

    e. The CONTRACTOR shall bring the preconstruction conference submittals in accordance with Section 01 33 00 - Contractor Submittals.

2. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the CONTRACTOR prior to the meeting date. However, the CONTRACTOR should be prepared to discuss all of the items listed below.

    a. Status of CONTRACTOR's insurance and bonds.

    b. CONTRACTOR's tentative schedules.

    c. Transmittal, review, and distribution of CONTRACTOR's submittals.

d. Processing applications for payment.

e. Maintaining record documents.

f. Critical work sequencing.

g. Field decisions and Change Orders.

h. Use of Site, office and storage areas, security, housekeeping, and OWNER's needs.

i. Major equipment deliveries and priorities.

j. CONTRACTOR's assignments for safety and first aid.

k. Daily Report Form which the ENGINEER will furnish.

l. Submittal Transmittal Form which the ENGINEER will furnish.

3. The CONTRACTOR will submit a preliminary Schedule of Values for the major components of the WORK at the Preconstruction Conference in consistent with Section 01 29 73 – Schedule of Values.

4. The OWNER will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.

5. The CONTRACTOR and its subcontractors should plan on the conference taking no less than 3 hours.

B. Progress Meetings

1. The ENGINEER will schedule and hold regular on-Site progress meetings at least weekly and at other times as requested by CONTRACTOR or as required by progress of the WORK. The CONTRACTOR, ENGINEER, and all subcontractors active on the Site shall attend each meeting. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers, and other subcontractors.

2. The OWNER will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the CONTRACTOR shall present any issues that may impact its progress with a view to resolve these issues expeditiously.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 14 00 – CONSTRUCTION CONSTRAINTS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. WORK shall be scheduled, sequenced, and performed in a manner which minimizes disruption to the operation and maintenance of existing facilities.

B. The CONTRACTOR shall incorporate the construction and schedule constraints of this Section in preparing the construction schedules.

1.2 EXISTING PLANT

A. The WORK shall be executed while the existing wastewater treatment plant is in operation. Operation of the existing plant shall not be jeopardized nor shall the efficiency of wastewater treatment be reduced as a result of the execution of the WORK.

B. Unless indicated otherwise, temporary pumping, piping, power, lighting, controls, instrumentation, alarms, security devices, and safety devices shall be provided by the CONTRACTOR whenever its activity or interruption due to its activity affects the existing facility.

C. The construction constraints in this Section do not include every item affecting the completion of the WORK, but are intended to describe the sequence of critical events necessary to minimize disruption to the ongoing treatment plant processes and to ensure compliance with NPDES Permit requirements. It shall be understood and agreed by the CONTRACTOR that the critical events described are not inclusive and that additional items of WORK not included may be required to minimize disruption and ensure compliance. Deviation from or modification of these suggested sequences is permitted if techniques and methods known to the CONTRACTOR will result in reducing disruption to the facility operation and maintaining treatment efficiency, and if deviation is approved in advance by the ENGINEER.

1.3 OPERATION OF PLANT EQUIPMENT

A. Operational functions or shutdown of the existing plant required to facilitate CONTRACTOR's operation will be done by the OWNER's personnel only.

B. The plant operation and maintenance personnel will cooperate in every way that is practical in order to facilitate CONTRACTOR's operation. However, certain shutdown and connections may only be permissible at times other than normal working hours such as nights or weekends. No additional payment will be made to the CONTRACTOR for any night, weekend, or holiday premium or overtime payments.

C. If it becomes necessary for the proper operation or maintenance of portions of the plant, the OWNER may require the CONTRACTOR to reschedule an approved shutdown. The CONTRACTOR shall then reschedule its operations so there shall be no conflict with necessary operations or maintenance of the plant. The CONTRACTOR shall, within 2 Days, furnish the ENGINEER a revised outage request and a plan for rescheduling the shutdown in accordance with the requirements of the construction schedule.

1.4 BYPASSING

A. Bypassing of untreated or partially treated sewage to surface waters or drainage courses is prohibited during construction. In the event accidental bypassing is caused by the CONTRACTOR's operations, the OWNER shall immediately be entitled to employ others to stop the bypassing and costs incurred therefore will be deducted from the CONTRACTOR's construction progress payments.

1.5 COMPLIANCE WITH NPDES PERMIT

A. The plant is operating under the terms of a NPDES permit issued by the US EPA. The NPDES permit specifies the water quality limits that the plant must meet prior to discharging its effluent. A copy of the NPDES permit is available for review by the CONTRACTOR. In scheduling and performing the WORK, the CONTRACTOR shall not, directly or indirectly, prevent the plant from achieving the discharge requirements. Penalties imposed on the OWNER as a result of any discharge violation caused by the actions of the CONTRACTOR or its employees, or subcontractors shall be borne in full by the CONTRACTOR, including fines, legal fees, and other expenses to the OWNER resulting directly or indirectly from such discharge violations. The OWNER may recover such sums by deductions from the construction progress payments.

B. The CONTRACTOR shall take necessary precautions to ensure that no damage occurs to the plant facilities, including piping, utilities, roads, and structures, that are to remain in operation and are not to be modified or replaced. Any temporary facilities, materials, equipment, and labor required for the plant to continue to meet the terms of the NPDES permit during construction shall be provided by the CONTRACTOR as part of the WORK. At the completion of work, such temporary facilities, materials, and equipment shall be removed from the Site as part of the WORK.

1.6 OUTAGE REQUESTS

A. Modifications to existing facilities, the construction of new facilities, and the connection of new to existing facilities may require the temporary outage or bypass of existing treatment processes or facilities. In such cases, the CONTRACTOR shall coordinate WORK with the ENGINEER as described below. The CONTRACTOR shall submit a detailed outage plan and time schedule for construction activities which will make it necessary to remove a pipeline, electrical circuit, equipment, structure, or other facilities from service.

B. The outage plans shall be submitted to the ENGINEER for acceptance a minimum of 2 weeks in advance of the time that such outages are required. The outage plans shall be coordinated with the construction schedule and shall meet the restrictions and conditions of this Section. The outage plan shall describe the CONTRACTOR's method for preventing bypassing of other treatment units; the length of time required to complete the operation; any necessary temporary power, controls, instrumentation, or alarms required to maintain control, monitoring, and alarms for the treatment plant processes; and the manpower, plant, and equipment which the CONTRACTOR shall provide in order to ensure proper operation of associated treatment units. Costs for preparing and implementing the outage plans shall be the responsibility of the CONTRACTOR as part of the WORK.

C. The CONTRACTOR shall not begin an alteration affecting existing facilities until specific written approval has been granted by the ENGINEER in each case.

D. The ENGINEER will coordinate the CONTRACTOR's planned procedure with the treatment facility personnel. The ENGINEER has the authority to modify any proposed shutdown procedures if such procedures would adversely impact the plant operations.

E. The ENGINEER shall be notified in writing at least one week in advance of the required outage if the schedule for performing the WORK has changed or if revisions to the outage plan are required. The CONTRACTOR shall provide written confirmation of the shutdown date and time 2 Days prior to the actual shutdown.

F. Only one pump may be out of service at any time. Therefore as each large pump is replaced, it must be demolished, replaced completely (including pump installation, piping, electrical wiring, and program) and fully tested and operational before the second pump can be taken out of service.

G. Transformer removal and associated electrical work shall only occur during the dry weather season (June 1st to September 30th).

1.7 TEMPORARY CONNECTIONS

A. Making connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be thoroughly planned in advance, and required equipment, materials, and labor shall be on hand at the time of undertaking the connections. WORK shall be completed as quickly as possible and with as little delay as possible and shall proceed continuously (24 hours a day and seven days a week) if necessary to complete modifications and/or connections in the minimum time.

B. The cost of any temporary facilities and night, weekend, or holiday activity and overtime payments required during process interruptions shall be included in the WORK.

C. Temporary facilities and piping shall be located to minimize interference with CONTRACTOR's construction facilities and OWNER's operation and maintenance of the wastewater treatment plant. Unless otherwise indicated, each temporary pipeline shall be of the same size as its connection to the existing or permanent facility at the downstream end of the pipeline. Piping materials shall be suitable for the material being conveyed and be as required in the Contract Specifications.

D. When temporary electrical power, controls, instrumentation, or alarms are required for routine continuous operations of existing or new equipment, the CONTRACTOR shall provide the necessary equipment and appurtenances. Prior to installing said equipment and appurtenances, CONTRACTOR shall furnish a submittal on the proposed components and installation for ENGINEER's review and approval.

E. A plan showing the size and location of the temporary facilities and piping shall be submitted to the ENGINEER at the same time as the outage plan required under this Section. Costs for design, provision, operation, and removal of temporary facilities and piping shall be part of the WORK.

1.8 CONSTRUCTION SEQUENCING

A. Construction activities shall be scheduled and sequenced to ensure continuous operation of the existing treatment facilities. The CONTRACTOR's scheduling shall develop construction sequencing so that the WORK will not adversely impact treatment. The CONTRACTOR shall be responsible for development of the construction sequencing. In implementing the construction sequencing, the CONTRACTOR shall

maintain the existing facilities in service until new facilities are constructed and are operational to supplement the existing capacity. When new facilities are operational, the existing facilities may be taken out of service. The following general guidelines shall be used by the CONTRACTOR in planning the sequence of construction.

1. Safe working conditions for personnel shall be maintained during rehabilitation, modification, and demolition WORK. The foregoing includes at least proper trench excavation, the provision of temporary equipment guards, supports, warning signs, walkways, covers over openings, handrailing, and protection of electrical equipment and power supply.

2. Temporary facilities shall be constructed in accordance with applicable codes and regulations to operate safely and properly.

3. Valves to be temporarily shut off during the WORK shall be tagged as such and shall be wired shut with a crimped lead seal and padlocked.

4. Electrical and mechanical equipment shall be similarly shut down.

1.9 PERMITS

A. The CONTRACTOR shall abide by the conditions of permits and shall obtain proof of satisfaction of conditions from issuers of permits prior to acceptance of the WORK by the OWNER.

B. Conditions affecting the CONTRACTOR are found in the following permits. Copies of permit conditions are attached at the end of this Section.

1. Building Permit

2. Electrical Permit

3. Structural Permit

1.10 SCHEDULE CONSTRAINTS

A. General: It is the CONTRACTOR's responsibility to coordinate and plan the construction activities to integrate each schedule constraint into performance of the overall WORK.

B. The listing of schedule constraints below does not mean that every constraint or special condition has been identified. The list does not substitute for the CONTRACTOR's coordination and planning for completion of the WORK within the Contract Times.

C. The following constraints affect the construction schedule.

1. The CONTRACTOR shall submit pump and VFD submittals no later than 30 calendar days following Notice to Proceed. Resubmittals shall be provided within 14 calendar days following receipt of ENGINEER comments.

2. No more than one large pump or small pump may be taken out of service at any given time. A total of 26 mgd of pumping capacity shall be maintained at all times during the dry weather season (June 1st to September 30th).

a. Subject to seasonal influent flow characteristics, the OWNER may require bypass pumping beyond June 1st.

3. Should the Contractor elect, with prior Owner approval, to remove a large pump from service during the wet weather season (October 1st to May 31st), the Contractor shall provide a temporary on-site backup bypass pumping system for the Influent Pump Station to provide an additional 14 mgd of standby pumping capacity in accordance with Section 01 50 10, Bypass Pumping.

4. Construction to be completed by February 28th, 2023. The OWNER may elect to defer pump installation until the dry season of 2023 to avoid the cost of bypass pumping.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 73 – SCHEDULE OF VALUES AND PAYMENT

PART 1 -- GENERAL

1.1 THE SUMMARY

A. This Section defines the process whereby the Schedule of Values (lump sum price breakdown) shall be developed and incorporated into the cost loading function of the CPM Schedule in accordance with the requirements of Section 01 32 16 – CPM Construction Schedule.

B. Monthly progress payment amounts will be determined from the monthly progress updates of the CPM Schedule activities.

C. Develop the Schedule of Values independent of but simultaneous with the development of the CPM Schedule activities and logic.

1.2 SUBMITTALS

A. Information submittals

1. Schedule of Values on Owner accepted form

2. Application for payment

3. Final application for payment

1.3 SCHEDULE OF VALUES

A. Submit a preliminary Schedule of Values for the major components of the WORK at the Preconstruction Conference in accordance with the requirements of Section 01 10 00 – Summary of Work. Submit in Microsoft Excel format.

B. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the CPM Schedule activities, furnish a sufficiently detailed breakdown in order to meet this requirement. At a minimum, submit proposed values for the following major WORK components:

1. Bonds and insurance premiums;

2. Mobilization / demobilization;

3. Preliminary and detailed progress schedule preparation

4. Equipment testing;

5. Facility startup;

6. Contract closeout;

7. Breakdown by Division 2 through 46 with appropriate subdivision of each specification;

8. The total value of other WORK not specifically included in the above items.

C. Review and Revisions

1. The CONTRACTOR and ENGINEER shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the ENGINEER, these are necessary to establish fair and reasonable allocation of values for the major WORK components.

2. Front-end loading will not be accepted.

3. The ENGINEER may require reallocation of major WORK components from items in the above listing if in the opinion of the ENGINEER such reallocation is necessary.

4. This review and any necessary revisions shall be completed within 15 Days from the date of Notice to Proceed.

1.4 CROSS-REFERENCE LISTING

A. To assist in the correlation of the Schedule of Values and the CPM Schedule, provide a cross-reference listing to be furnished in 2 parts:

1. In the first part, list each scheduled activity with the breakdown of the respective valued items making up the total cost of the activity; and,

2. In the second part, list the valued item with the respective schedule activity or activities that make up the total indicated cost.

B. In the case where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values), indicate the total cost for each Schedule of Value item.

C. Update and submit these listings in conjunction with the CPM monthly submittals as indicated in Section 01 32 16 – CPM Construction Schedule.

D. Incorporate approved Change Orders reflected in the CPM Schedule into the Schedule of Values as a single unit identified by the Change Order number.

1.5 CHANGES TO SCHEDULE OF VALUES

A. Changes to the CPM Schedule which additional activities not included in the original schedule but included in the original WORK (schedule omissions) shall have values assigned as approved by the ENGINEER.

B. Reduce other activity values in order to provide equal value adjustment increases for added activities, as approved by the ENGINEER.

C. In the event that the CONTRACTOR and ENGINEER agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

1.6 APPLICATIONS FOR PAYMENT

A. Transmittal summary form: attach one Summary form with each detailed Application for Payment and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.

B. Use detailed Application for Payment Form acceptable to the OWNER.

C. Include separate line item for each Owner-directed Change Order and Owner-directed Work Change Directives executed prior to date of submission.

1.7 PAYMENT

A. Payment of all Work shown or specified in Contract Documents is included in the Lump Sum Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

1.8 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for the following:

1. Loading, hauling, or disposing of rejected material.

2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.

3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.

4. Material not unloaded from transporting vehicle.

5. Defective Work not accepted by Owner.

6. Material on hand after completion of Work.

1.9 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings and preliminary operation and maintenance data is acceptable to the OWNER.

B. Final Payment: Will be made only for products incorporated into the Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 013216 - CPM CONSTRUCTION SCHEDULE

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall schedule the WORK in accordance with this Section.

B. Development of the schedule, monthly payment requisitions and project status reporting requirements of the Contract shall employ computerized Critical Path Method (CPM) scheduling.

C. The CPM schedule and related reports should be prepared with the current version of Microsoft Project.

1.2 DEFINITIONS

A. CPM Scheduling: The term shall be interpreted to be generally as outlined in the Association of General Contractors (AGC) publication, "The Use of CPM in Construction." except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this Section and the AGC document, this Section shall govern.

B. Float: Unless otherwise indicated herein, float and total float are synonymous. Total float is the period of time measured by the number of Days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, then that activity becomes part of the critical path and controls the end date of the WORK. Thus, delay of a non-critical path activity beyond its float period will cause delay to the project itself.

1.3 SCHEDULING QUALIFICATION SUBMITTALS

A. CONTRACTOR shall submit a statement of computerized CPM capability within 15 Days after Notice to Proceed to verify that either: (1) the CONTRACTOR has in-house capability qualified to use CPM techniques and the Microsoft Project software or (2) that the CONTRACTOR will arrange for the services of a CPM consultant so qualified. In either event the statement shall identify the individual who will perform the CPM scheduling and shall describe the construction projects required below. The statement shall also identify the contact persons for the referenced projects with current telephone and address information.

B. Criteria: The individual performing scheduling shall have successfully applied computerized CPM technique to at least 2 projects of similar nature, scope, and value not less than one half the Total Bid Price of this project.

1.4 INITIAL SCHEDULE SUBMITTALS

A. Where submittals are required hereunder, the CONTRACTOR shall submit 4 copies of each submittal item.

B. The CONTRACTOR shall submit 2 schedule documents at the Preconstruction Conference which serve as the CONTRACTOR's plan of operation for the initial 60 Day

period of the Contract Times and identify the manner in which the CONTRACTOR intends to complete the WORK within the Contract Times.

1. 60 Day Plan of Operation: During the initial 60 Days of the Contract Times, the CONTRACTOR shall conduct operations in accordance with a 60 Day bar chart type schedule. The chart so prepared shall show accomplishment of the CONTRACTOR's early activities (mobilization, permit acquisition, submittals necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, CPM submittals, initial sitework and other submittals and activities required in the first 60 Days).

2. Project Overview Bar Chart: The overview bar chart shall indicate the major components of the WORK and the sequence relations between major components and subdivisions of major components. The overview bar chart shall indicate the relationships and time frames in which the various components of the WORK will be made substantially complete and placed into service in order to meet the required milestones. Sufficient detail shall be included to subdivide major components in such activities as (1) excavation, (2) foundation subgrade preparation, (3) foundation concrete, (4) completion of structural concrete, (5) major mechanical WORK, (6) major electrical WORK, (7) instrumentation and control WORK, and (8) other important WORK for each major facility within the overall project scope. Planned durations and start dates shall be indicated for each WORK item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 36-inches by 60-inches in size. No more than 4 sheets shall be employed to present this overview information.

C. The ENGINEER and the CONTRACTOR shall meet to review and discuss the 60 Day plan of operation and project overview bar chart within 5 Days after submittal to the ENGINEER. The ENGINEER's review and comment on the schedules will be limited to conformance with the sequencing and milestone requirements in the Contract Documents. The CONTRACTOR shall make corrections to the schedules necessary to comply with the requirements and shall adjust the schedules to incorporate any missing information requested by the ENGINEER.

1.5 CPM SCHEDULE SUBMITTALS

A. Original CPM Schedule Submittal: Within 45 Days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall submit for review by the ENGINEER a hard copy of the CPM schedule and the computerized schedule report tabulations. The data shall be compatible with Microsoft Project to generate network diagrams and schedule reports identical to the hard copies submitted. This submittal shall have already been reviewed and approved by the CONTRACTOR's Project Manager, superintendent, and estimator prior to submission. The CPM schedule shall be a time-scaled network diagram of the "i-j" activity-on-arrow or precedence type. The network diagram shall describe the activities to be accomplished and their logical relationships and shall show the critical path.

B. The computerized schedule report tabulations shall include the following:

1. Report of activities sorted by activity number: Activity numbers, where practical, shall correlate to the area numbers designated on the Contract Drawings as further defined in Section 01 10 00 – Summary of Work.

2. Report of activities sorted by early start date.

3. Report of activities sorted by total float.

4. Report of activities sorted by responsibility code. Responsibility codes shall be established for the CONTRACTOR, ENGINEER, OWNER, Subcontractors, Suppliers, etc. These codes shall be identified in the Network Diagram.

5. A successor-predecessor report which shall identify the successor and predecessor activities for each activity and ties between schedule activities.

C. Analysis

1. Early Completion

a. The CONTRACTOR may show early completion on the original CPM submittal if that is its plan.

b. An original CPM submittal showing early completion shall either be accompanied by:

1) Request for change of Contract Times at zero change of Contract Price, accompanied by documentation demonstrating that the Bid was based on early completion, or

2) Demonstration in the submittal that the time difference between early completion and the original Contract Time is total float.

c. An early completion schedule unaccompanied by one of these will not be accepted.

d. The ENGINEER will analyze a request for Change Order in accordance with the General Conditions.

2. Float Ownership: Neither the OWNER nor the CONTRACTOR owns the float time. The project owns the float time. Liability for delay to the project completion date rests with the party causing the delay. For example, if Party A is responsible for consuming a portion of the float time and Party B later consumes the remainder of the float time plus additional time beyond the float time, Party B is responsible for the time that is a delay past the completion date. Party A would not be responsible for any delay since it did not consume all the float time, additional float time remained after its delay, and the completion date was unaffected by its tardiness.

D. Original CPM Schedule Review Meeting: The CONTRACTOR shall, within 55 Days from the commencement date stated in the Notice to Proceed, meet with the ENGINEER to review the original CPM schedule submittal. The ENGINEER's review will be limited to conformance with the Contract Documents. However, the review may also include:

1. Clarifications of the design intent.

2. Directions to include activities and information missing from the submittal.

3. Requests to the CONTRACTOR to clarify and revise the schedule.

E. Revisions to the Original CPM Schedule: Within 65 Days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall revise the original CPM schedule submittal to address review comments from the original CPM schedule review

meeting and resubmit the network diagrams and reports for the ENGINEER's review. The ENGINEER, within 14 Days from the date that the CONTRACTOR submitted the revised schedule will either (1) accept the schedule as submitted, or (2) advise the CONTRACTOR in writing to review any part or parts of the schedule which either do not meet the requirements or are unsatisfactory for the ENGINEER to monitor the progress and status of WORK or evaluate monthly payment requests by the CONTRACTOR. The ENGINEER may accept the schedule conditional upon the first monthly CPM schedule update correcting deficiencies identified. When the schedule is accepted, it shall be considered as the "Original CPM Construction Schedule" until an updated schedule has been submitted. The ENGINEER reserves the right to require that the CONTRACTOR adjust, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the monitoring of WORK or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.

F. Acceptance

1. Acceptance of the CONTRACTOR's schedule by the ENGINEER and OWNER will be based solely upon compliance with the requirements. By way of the CONTRACTOR assigning activity durations and proposing the sequence of the WORK, the CONTRACTOR agrees to utilize sufficient and necessary management and other resources to perform WORK in accordance with the schedule. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.

2. Submission of the CONTRACTOR's progress schedule to the ENGINEER shall not relieve the CONTRACTOR of total responsibility for scheduling, sequencing, and pursuing the WORK to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed WORK.

G. Monthly Updates and Periodic CPM Schedule Submittals

1. Following acceptance of the CONTRACTOR's original CPM schedule, the CONTRACTOR shall monitor the progress of the WORK and adjust the schedule each month to reflect actual progress and any changes in planned future activities. Each schedule update submittal shall be complete including information requested in the original schedule submittal and be in the schedule report format indicated below. Each update shall continue to show WORK activities including those already completed. Completed activities shall accurately depict "as built" information by indicating when the WORK was actually started and completed.

2. Neither the submission nor the updating of the CONTRACTOR's original schedule submittal nor the submission, updating, change, or revision of any other report, curve, schedule, or narrative submitted by the CONTRACTOR, nor the ENGINEER's review or acceptance of any such report, curve, schedule, or narrative shall have the effect of amending or modifying in any way the Contract Times or milestone dates or of modifying or limiting in any way the CONTRACTOR's obligations under the Contract. Only a signed, fully executed Change Order can modify contractual obligations.

3. The monthly schedule update submittal will be reviewed with the CONTRACTOR during a monthly construction progress meeting held on the 20th Day of each month. The goal of these meetings is to enable the CONTRACTOR and the ENGINEER to initiate appropriate remedial action to minimize any known or foreseen delay in completion of the WORK and to determine the amount of WORK completed since the last schedule update. The status of the WORK will be determined by the percent

complete of each activity in the updated CPM schedule. These meetings are considered a critical component of the overall monthly schedule update submittal, and the CONTRACTOR shall have appropriate personnel attend. As a minimum, the CONTRACTOR's Project Manager and superintendent shall attend these meetings. The CONTRACTOR shall plan on the meeting taking no less than 6 hours. Within 7 Days after the monthly progress meeting, the CONTRACTOR shall submit the revised CPM schedule, the revised CPM computerized tabulations, the revised successor/predecessor report, the project status reports as defined below and the CONTRACTOR's Application for Payment. Within 5 Days of receipt of the revised submittals, the ENGINEER will either accept or reject the monthly schedule update submittal. If rejected, the update shall be corrected and resubmitted by the CONTRACTOR before the Application for Payment for the update period will be processed.

H. Schedule Revisions: The CONTRACTOR shall highlight or otherwise identify changes to the schedule logic or activity durations made from the previous schedule. The CONTRACTOR shall modify any portions of the CPM schedule which become infeasible because activities are behind schedule or for any other valid reason.

1.6 CHANGE ORDERS

A. Upon approval of a Change Order or upon receipt by the CONTRACTOR of authorization to proceed with additional WORK, the change shall be reflected in the next submittal of the CPM Schedule. The CONTRACTOR shall utilize a sub-network in the schedule depicting the changed WORK and its effect on other activities. This sub-network shall be tied to the main network with appropriate logic so that a true analysis of the critical path can be made. Whenever the CONTRACTOR believes that a Change Order will extend the Contract Times, the sub-network analysis herein shall be submitted with the price proposal for the change. If the CONTRACTOR does not submit the sub-network demonstrating that the change affects the Contract Times, then no subsequent claim for additional time due to the change will be accepted.

1.7 CPM STANDARDS

A. Construction Schedules: Construction schedules shall include a graphic network diagram and computerized schedule reports as required below for status reporting.

B. Networks: The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets. Individual sheets shall not exceed 36-inches by 60-inches.

C. Construction and procurement activities shall be presented in a time-scaled format with a calendar time line along the entire sheet length. Each activity arrow or node shall be plotted so that the beginning and completion dates of each activity are accurately represented along the calendar time line. Every activity shall use symbols that clearly distinguish between critical path activities, non-critical activities, and free float for each non-critical activity. Activity items shall be identified by their activity number, responsibility code, duration, and dollar value. Non-critical path activities shall show total float time in scale form by utilizing a dotted line or some other graphical means.

D. Duration Estimates: The duration estimate for each activity shall be computed in Days and shall represent the single best estimate considering the scope of the WORK and resources planned for the activity. Except for certain non-labor activities such as curing

of concrete or delivery of materials, activity duration shall not exceed 10 Days nor be less than one Day, unless otherwise accepted by the ENGINEER.

1.8 SCHEDULE REPORT FORMAT

A. Schedule Reports: Schedule reports shall be prepared based on the CPM schedule, shall be submitted on paper and electronically, depending on file size, and shall include the following minimum data for each activity:

1. Activity numbers and responsibility codes.
2. Work Order No.
3. CIP No.
4. Estimated activity duration.
5. Activity description.
6. Activity percent completion.
7. Early start date (calendar dated).
8. Early finish date (calendar dated).
9. Late start date (calendar dated).
10. Late finish date (calendar dated).
11. Status (whether critical).
12. Total float for each activity.
13. Free float for each activity.

B. Project Information: Each Schedule Report shall be prefaced with the following summary data:

1. Project name.
2. CONTRACTOR name.
3. Type of tabulation.
4. Project duration.
5. Contract Times (as revised by Change Orders).
6. The commencement date stated in the Notice to Proceed.
7. The data date and plot date of the CPM Schedule.
8. If an update, cite the new schedule completion date.

1.9 PROJECT STATUS REPORTING

A. The CONTRACTOR shall furnish monthly project status reports (overview bar chart and a written narrative report) in conjunction with the revised CPM schedules as indicated above. Status reporting shall be in the form below.

B. The CONTRACTOR shall prepare and submit monthly an overview bar chart schedule of the major project components. The overview bar chart schedule shall be a summary of the current CPM schedule (original and as updated and adjusted throughout the entire construction period). The major project components shall be represented as time bars which shall be subdivided into various types of WORK including demolition, concrete construction, and mechanical, electrical and instrumentation installations. Major components shall include modifications to existing structures, tie-ins to existing facilities, and plant startups.

C. Each major component and subdivision shall be accurately plotted consistent with the project overview bar chart above. It shall represent the same status indicated by early start and finish activity information contained in the latest update of the CPM schedule. In addition, a percent completion shall be indicated for each major component and subdivision. The initial submittal of the overview bar chart schedule shall be made at the time that the revised original CPM schedule is submitted to the ENGINEER. The CONTRACTOR shall amend the overview schedule to include any additional detail required by the ENGINEER. The CONTRACTOR shall include any additional information requested by the ENGINEER at any time during the construction of the WORK.

D. The CONTRACTOR shall prepare monthly written narrative reports of the status of the project for submission to the ENGINEER. Status reports shall include:

1. The status of major project components (percent complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.

2. The progress made on critical activities indicated on the CPM schedule.

3. Explanations for any lack of WORK on critical path activities planned for the last month.

4. Explanations for any schedule changes, including changes to the logic and to activity durations.

5. A list of the critical activities scheduled to be performed in the next 2 months.

6. The status of major material and equipment procurement.

7. The value of materials and equipment properly stored at the Site but not yet incorporated into the WORK.

8. Any delays encountered during the reporting period.

9. An assessment of inclement weather delays and impacts to the progress of the WORK.

E. The CONTRACTOR may include any other information pertinent to the status of the WORK. The CONTRACTOR shall include additional status information requested by the ENGINEER.

1.10 INCLEMENT WEATHER PROVISIONS OF THE SCHEDULE

A. The CONTRACTOR's schedule shall include at least the number of Days of delay due to unusually severe weather as required by the Supplementary General Conditions.

1.11 LIQUIDATED DAMAGES

A. If any submittal required by this Section is determined by the ENGINEER to be incomplete or is submitted later than required, the OWNER will suffer financial loss, and accordingly, the CONTRACTOR shall pay liquidated damages in accordance with Article 4 of the Agreement.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 013300 - CONTRACTOR SUBMITTALS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Wherever submittals are required by the Contract Documents, submit them to the ENGINEER for tracking manually via spreadsheet or similar means.

B. Within 7 Days after the date of commencement as stated in the Notice to Proceed, submit the following items for review:

1. Submittal Schedule

a. Submit a preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("or equal") submittals listed in the Bid.

b. Base the schedule of submittals on CONTRACTOR's priority, planned construction sequence and schedule, long-lead items, and size of submittal package.

c. Allow time for resubmittals.

2. Submit a list of permits and licenses the CONTRACTOR shall obtain, indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.

1.2 PRECONSTRUCTION CONFERENCE SUBMITTALS

A. At the preconstruction conference, submit the following items to the ENGINEER for review:

1. a revised schedule of Shop Drawings, Samples, and proposed Substitution ("or-equal") submittals listed in the Bid;

2. a list of permits and licenses the CONTRACTOR shall obtain, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit;

3. a preliminary schedule of values in accordance with the General Conditions and Section 01 29 73 – Schedule of Values and Payment;

4. a 60-Day plan of operation for initial phase of construction;

5. a project overview schedule in accordance with the General Conditions and Section 01 32 16 - CPM Construction Schedule.

6. a layout of the field office

7. Staging Plan

1.3 SHOP DRAWINGS

A. Wherever called for in the Contract Documents or where required by the ENGINEER, furnish a digital copy (PDF).

B. Shop Drawings may include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs, catalog sheets, data sheets, and similar items.

C. Whenever the CONTRACTOR is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the Project is located, unless otherwise indicated.

D. Transmittal Form

1. Shop Drawing submittals shall be accompanied by the ENGINEER's standard submittal transmittal form, a reproducible copy of which is available from the ENGINEER.

2. A submittal without the form, or where applicable items on the form have not been completed, will be returned for resubmittal.

E. Organization

1. Use a single submittal transmittal form for each technical specification Section or item or class of material or equipment for which a submittal is required.

2. A single submittal covering multiple Sections will not be accepted, unless the primary specification references other Sections for components: For example, if a pump Section references other Sections for the motor, shop-applied protective coating, anchor bolts, local control panel, and variable frequency drive, a single submittal would be accepted, whereas a single submittal covering vertical turbine pumps and horizontal split-case pumps would not be accepted.

3. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components.

4. Relate the submittal components to specification paragraph and subparagraph, Drawing number, detail number, schedule title, room number, or building name, as applicable.

5. Unless otherwise indicated, match terminology and equipment names and numbers used in the submittals with those used in the Contract Documents.

F. Format

1. Minimum sheet size shall be 8-1/2 inches by 11 inches, and maximum sheet size shall be 24 inches by 36 inches.

2. Number every page in a submittal in sequence.

3. Collate and staple or bind, as appropriate, each copy of a submittal; the ENGINEER will not collate sheets or copies.

4. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with complete pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports.

5. Present a sufficient level of detail for assessment of compliance with the Contract Documents.

6. Numbering

    a. Assign to each submittal a unique number.

    b. Number the submittals sequentially, with the submittal numbers clearly noted on the transmittal.

    c. Assign original submittals a numeric submittal number followed by a decimal point and a numeric digit in order to distinguish between the original submittal and each resubmittal: For example, if submittal "25.1" requires a resubmittal, the first resubmittal will bear the designation "25.2" and the second resubmittal will bear the designation "25.3," and so on.

G. Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.

H. ENGINEER's Review

1. Except as otherwise indicated, the ENGINEER will return prints of each submittal to the CONTRACTOR with comments noted thereon, within 30 Days following receipt by the ENGINEER.

2. It is considered reasonable that the CONTRACTOR shall make a complete and acceptable submittal to the ENGINEER by the first resubmittal on an item.

3. The OWNER reserves the right to withhold monies due to the CONTRACTOR to cover additional costs of the ENGINEER's review beyond the first resubmittal.

4. The ENGINEER'S maximum review period for each submittal or resubmittal will be 30 Days; thus, for a submittal that requires 2 resubmittals before it is complete, the maximum review period could be 90 Days.

I. If a submittal is returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission will not be required.

J. If a submittal is returned marked "MAKE CORRECTIONS NOTED," the CONTRACTOR shall make the corrections on the submittal, but formal revision and resubmission will not be required.

K. Resubmittals

1. If a submittal is returned marked "AMEND-RESUBMIT," the CONTRACTOR shall revise the submittal and resubmit the required number of copies.

2. Resubmittal of portions of multi-page or multi-drawing submittals will not be accepted: For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as "AMEND-RESUBMIT," the submittal as a whole is deemed "AMEND-RESUBMIT," and 10 drawings are required to be resubmitted.

3. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.

L. Rejected Submittals

1. If a submittal is returned marked "REJECTED-RESUBMIT," it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or is a substitution request not submitted in accordance with Section 01 60 00 – Products, Materials, Equipment, and Substitutions.

2. In the latter case, the CONTRACTOR shall submit the substitution request according to the requirements of Section 01 60 00 – Products, Materials, Equipment, and Substitutions.

3. The resubmittal of rejected portions of a previous submittal will not be accepted.

M. The fabrication of an item may commence only after the ENGINEER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

N. Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.

O. Review by CONTRACTOR

1. Submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR prior to submission to the ENGINEER.

2. Each submittal shall be dated and signed by the CONTRACTOR as being correct and in strict conformance with the Contract Documents.

3. In the case of Shop Drawings, each sheet shall be so dated and signed.

4. Any deviations from the Contract Documents shall be noted on the transmittal sheet.

5. The ENGINEER will only review submittals that have been so verified by the CONTRACTOR.

6. Non-verified submittals will be returned to the CONTRACTOR without action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.

P. Conformance

1. Corrections or comments made on the CONTRACTOR's Shop Drawings during review shall not relieve the CONTRACTOR from compliance with Contract Drawings and Specifications.

2. A lack of comments made on the CONTRACTOR’s Shop Drawings during review shall not relieve the CONTRACTOR from compliance with Contract Drawings and Specifications.

3. Review is for conformance to the design concept and general compliance with the Contract Documents only.

4. The CONTRACTOR shall be responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating WORK with the trades, and satisfactory and safe performance of the WORK.

1.4 SAMPLES

A. Quantity

1. The CONTRACTOR shall submit the number of samples indicated by the Specifications.

2. If the number is not indicated, submit not less than 3 samples.

3. Where the quantity of each sample is not indicated, submit such quantity as necessary for proper examination and testing by the methods indicated.

B. Identification and Distribution

1. Individually and indelibly label or tag each sample, indicating the salient physical characteristics and the manufacturer's name.

2. Upon acceptance by the ENGINEER, one set of the samples will be stamped and dated by the ENGINEER and returned to the CONTRACTOR, one set of samples will be retained by the ENGINEER, and one set shall remain at the Site in the ENGINEER's field office until completion of the WORK.

C. Selection

1. Unless otherwise indicated, the ENGINEER will select colors and textures from the manufacturer's standard colors and standard materials, products, or equipment lines.

2. If certain samples represent non-standard colors, materials, products, or equipment lines that will require an increase in Contract Times or Price, the CONTRACTOR shall clearly state so on the transmittal page of the submittal.

D. The CONTRACTOR shall schedule sample submittals such that:

1. Sample submittals for color and texture selection are complete so the ENGINEER has 45 Days to assemble color panels and select color- and texture-dependent products and materials without delay to the construction schedule; and,

2. After the ENGINEER selects colors and textures, the CONTRACTOR has sufficient time to provide the products or materials without delay to the construction schedule.

3. The Contract Times will not be extended for the CONTRACTOR's failure to allow enough review and approval or selection time, failure to submit complete samples requiring color or texture selection, or failure to submit complete or approvable samples.

1.5 TECHNICAL MANUAL

A. The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical, and instrumentation equipment in an organized manner in the Technical Manual.

B. The manual shall be written such that it can be used and understood by the OWNER's operation and maintenance staff.

C. Categories

1. The Technical Manual shall be subdivided first by Specification Section number; second, by equipment item; and last, by "Category." The following "Categories" shall be addressed (as applicable):

a. Category 1 - Equipment Summary

1) Summary: A table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.

2) Form: The ENGINEER will supply an Equipment Summary Form for each item of mechanical, electrical, and instrumentation equipment in the WORK. The CONTRACTOR shall fill in the relevant information on the form and include it in Part 1.

b. Category 2 - Operational Procedures

1) Procedures: Manufacturer-recommended procedures on the following shall be included in Part 2:

Installation
Adjustment
Startup
Location of controls, special tools, equipment required, or related instrumentation needed for operation
Operation procedures
Load changes
Calibration
Shutdown
Troubleshooting
Disassembly
Reassembly
Realignment
Testing to determine performance efficiency
Tabulation of proper settings for pressure relief valves, low and high pressure switches, and other protection devices
List of all electrical relay settings including alarm and contact settings

c. Category 3 - Preventive Maintenance Procedures

1) Procedures: Preventive maintenance procedures shall include manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place.

2) Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

d. Category 4 - Parts List

1) Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.

2) Drawings: Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.

e. Category 5 - Wiring Diagrams

1) Diagrams: Category 5 shall include complete internal and connection wiring diagrams for electrical equipment items.

f. Category 6 - Shop Drawings

1) Drawings: This category includes approved shop or fabrication drawings with ENGINEER comments and corrections incorporated, complete with dimensions.

g. Category 7 - Safety

1) Procedures: This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

h. Category 8 - Documentation:

1) Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the Technical Specifications shall be placed in this category.

D. Format

1. Bind each Technical Manual in standard size 3-ring hardcover binders, labeled on the spine and cover with Project name, OWNER's project number, Specification Section number, equipment name, and equipment identification number

2. Each Binder shall contain its own detailed table of contents at the front, plus a summary level table of contents information for the other binders in a multi-binder set.

3. Documents in binders shall be 3-hole punched, with no text punched out, and pages larger than 8-1/2 by 11 shall be folded to 8-1/2 by 11 size.

4. Provide a USB drive with electronic files with each final set of Technical Manuals, as follows:

a. Project-specific files created in Microsoft Office;

b. AutoCad 2021;

c. Adobe Acrobat portable document format (PDF) or other software required by the Specifications; and,

d. Manufacturer literature in Adobe Acrobat portable document format (PDF).

E. Review Process

1. Furnish 3 draft Technical Manuals for each Specification Section that requires a manual.

2. The ENGINEER will retain one copy, will forward one copy to the OWNER, and will return one copy to the CONTRACTOR with review comments.

3. Incorporate comments into the draft and submit 5 identical copies of the final manual for acceptance.

F. Submittal and Corrections

1. The WORK under this Contract involves start-up and commissioning of pumps and related equipment.

2. The manuals shall be completed for each piece of equipment prior to placing equipment into service and prior to training of the OWNER's personnel.

3. Except as otherwise indicated, submit the manuals for review in final form a minimum of 30 Days prior to the start of performance testing for each piece of equipment.

4. Discrepancies found by the ENGINEER shall be corrected within 30 Days from the Date of written notification by the ENGINEER.

G. Manuals that are incomplete or unacceptable at the schedule criterion above will constitute sufficient justification for the OWNER to retain the amount in Paragraph "Technical Manual Submittals" of Schedule of Values, from any monies due the CONTRACTOR.

1.6 SPARE PARTS LIST

A. General

1. Furnish to the ENGINEER 5 identical sets of spare parts information for mechanical, electrical, and instrumentation equipment as part of the Technical Manual.

2. The spare parts list shall include those spare parts that each manufacturer recommends to be maintained by the OWNER in inventory.

B. Sources and Pricing

1. The spare parts list shall include a current list price of each spare part.

2. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts, to assist the OWNER in ordering.

C. Format

1. Cross-reference the spare parts lists to the equipment numbers designated in the Contract Documents.

2. The spare parts lists shall be bound in standard-size, 3-ring, loose-leaf, vinyl plastic, hard-cover binders suitable for bookshelf storage.

3. The binder ring size shall not exceed 2-1/2 inches.

4. Each copy of the spare parts lists shall be accompanied by a CD containing the lists in electronic format, in files created under Microsoft Office.

1.7 AS-BUILT DRAWINGS

A. On-Site Drawings Set

1. Maintain one set of Drawings at the Site for the preparation of as-built drawings.

2. On this set, mark every project condition, location, configuration, and any other change or deviation which may differ from the Contract Drawings at the time of award, including buried or concealed construction and utility features that are revealed during the course of construction.

3. Give special attention to recording the horizontal and vertical location of buried utilities that differ from the locations indicated, or that were not indicated on the Contract Drawings.

4. Supplement the as-built drawings by any detailed sketches as necessary or as directed, in order to fully indicate the WORK as actually constructed.

5. The as-built drawings are the CONTRACTOR's representation of as-built conditions, shall include revisions made by addenda and change orders, and shall be maintained up-to-date during the progress of the WORK.

6. Use red ink for alterations and notes.

7. Notes shall identify relevant Change Orders by number and date.

B. Submittal

1. Submit paper copies of the as-built drawings on the 20th Day of every third month after the month in which the Notice to Proceed is given, as well as at completion of the WORK.

2. Failure to submit complete as-built drawings on or before the 20th Day will enact the liquidated damages clause for interim record drawing submittals described in Article 3 of the Agreement.

C. In the case of those drawings that depict the detail requirement for equipment to be assembled and wired in the factory, such as motor control centers and the like, update the as-built drawings by indicating those portions which are superseded by Change Order drawings or final Shop Drawings, and by including appropriate reference information describing the Change Orders by number and the Shop Drawings by manufacturer, drawing, and revision numbers.

D. Unacceptable Drawings

1. Disorganized or incomplete as-built drawings will not be accepted.

2. The CONTRACTOR shall revise them and resubmit within 10 Days.

E. As-built drawings shall be accessible to the ENGINEER during the construction period.

F. Final Payment

1. Final payment will not be acted upon until the as-built drawings have been completed and delivered to the ENGINEER.

2. Up-to-date as-built drawings shall be in the form of a set of prints with carefully plotted information overlaid and an electronic form under Microsoft Office, AutoCad, Adobe Acrobat (PDF), or other software required by the Specifications.

G. Information submitted by the CONTRACTOR will be assumed to be correct, and the CONTRACTOR shall be responsible for the accuracy of such information

1.8 QUALITY CONTROL (QC) SUBMITTALS

A. Quality control submittals are defined as those required by the Specifications to present documentary evidence to the ENGINEER that the CONTRACTOR has satisfied certain requirements of the Contract Documents.

B. Unless otherwise indicated, QC submittals shall be submitted:

1. Before delivery and unloading, for the following types of submittals:

a. Manufacturers' installation instructions

b. Manufacturers' and Installers' experience qualifications

c. Ready mix concrete delivery tickets

d. Design calculations

e. Affidavits and manufacturers' certification of compliance with indicated product requirements

f. Laboratory analysis results

g. Factory test reports

2. Within 30 Days of the event documented for the following types of submittals:

a. Manufacturers' field representative certification of proper installation

b. Field measurement

c. Field test reports

d. Receipt of permit

e. Receipt of regulatory approval

C. The ENGINEER will record the date that a QC submittal was received and review it for compliance with submittal requirements, but the review procedures above for Shop Drawings and samples will not apply.

1.9 CONSTRUCTION PHOTOGRAPHS

A. General

1. Furnish construction photographs showing the progress of the WORK.

2. Place a label the back with the date of photographing, the project title, a short description of what is in the photograph, and the direction the camera is facing.

B. Prints

1. Starting when the WORK begins and continuing for as long as the WORK is in progress, take not less than 6 photographs at intervals not more than 2 weeks apart, consisting of different subjects or angles or view at different locations of progress on the Site.

2. Furnish photographs to the ENGINEER within 2 weeks after exposure.

3. The photographs shall become sole property of the OWNER upon submittal by the CONTRACTOR.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 17 – STRUCTURAL DESIGN, SUPPORT AND ANCHORAGE

PART 1 -- GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide calculations and details for structural and non-structural components, supports, and anchorages as required by the Contract Documents and the 2018 IBC . The contractor shall furnish and install all such structural and non-structural components, supports, and anchorages in accordance with the calculations and details.

B. The Contractor shall provide calculations and details for structures and non-building structures, supports, and anchorages as required by the Contract Documents and the 2018 IBC. The contractor shall furnish and install all such structures and non-building structures, supports, and anchorages in accordance with the calculations and details.

C. Where a conflict exists between the requirements of the Contract Documents and the 2018 IBC 2019 CBC, the more stringent requirement shall apply.

1. Exemptions to this requirement that are permitted by the 2018 IBC , ASCE 7, or any other applicable Building Code or Reference Document, shall not apply unless the exemption is explicitly listed within this Specification Section.

D. Design parameters used to determine Seismic design forces shall be as listed herein.

1.2 REFERENCES

A. IBC 2018 International Building Code

B. ASCE 7 American Society of Civil Engineers Standard 7-16 – Minimum Design Loads for Buildings and Other Structures.

C. ACI 318 Building Code Requirements for Structural Concrete (2019 edition)

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 013300 - Contractor Submittals.

B. Calculations and Details

1. Calculations and details are considered a Deferred Submittal as defined in the IBC .

2. Calculations and details shall be complete, accurate, and in accordance with the requirements of the IBC and ASCE 7, and shall be signed and sealed by a Professional Engineer registered in the State of Washington.

3. Calculations shall be clear and concise and show equipment and other non-structural component anchorage forces and the capacities of the anchorage elements proposed by the Contractor. The calculations shall substantiate a complete load path from the component or equipment being anchored into the supporting structure or foundation.

4. The calculations and details shall demonstrate a complete lateral and vertical load path, and shall clearly indicate all forces imposed on the supporting structure.

5. Calculations and details are required for all Non-Structural components, supports, anchorages, and attachments.

    a. Non-Structural components shall include all architectural, mechanical, and electrical components, equipment, piping, ductwork, and all other similar or related appurtenances necessary to produce the complete architectural, mechanical, and electrical systems.

6. When the Contract Documents require the CONTRACTOR to design structures or structural components, calculations and details for those structures and structural components, and their supports, anchorages, and attachments, are required.

7. When computer generated calculations and analyses are included as part (or as the whole) of the calculations, the calculations shall include, but not be limited to, the following: derivations of all input parameters; clear indication of the applicable load combinations and building code equations; diagrams of all members, geometry, loads, forces, reactions and deflections, for all components and connections; and output results demonstrating all stress, force, deflection and other Contract Document and building code requirements have been satisfied.

8. All calculations associated with anchorage into concrete or masonry shall be done using Strength Level forces, and shall be in accordance with the applicable provisions of ACI 318 and ACI 530, respectively.

9. Refer to Part 2 below for additional requirements.

1.4 SEISMIC DESIGN CRITERIA

A. Design Requirements

1. Design Parameters:

    a. Risk Category: III.

    b. Seismic Design Category: D.

    c. Mapped MCE spectral acceleration at short period: S_S = 0.88.

    d. Mapped MCE spectral acceleration at 1-second period: S_1 = 0.39.

    e. Site Class: D.

    f. Design spectral acceleration at short period: S_{DS} = 0.71.

    g. Long period transition period: T_L = 16 seconds

    h. Response modification coefficient, R: In accordance with ASCE 7, Tables 12.2-1, 12.14-1, 15.4-1 and 15.4-2.

    i. Seismic Importance Factor, I: 1.25.

    j. Component amplification factor, a_p: In accordance with ASCE 7, Tables 13.5-1 and 13.6-1.

k. Component response modification factor, R_p: In accordance with ASCE 7, Tables 13.5-1 and 13.6-1.

2. The following components are exempted from the seismic design requirements:

a. Exemptions shall be as indicated in ASCE 7 Chapter 13.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Non-Structural Component Supports and Anchors

1. Unless otherwise indicated, non-structural component supports, anchors, and restrainers shall be adequately designed for all applicable static, dynamic, operational, seismic loads.

a. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches of the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel or engineered framing support systems. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.

b. All equipment and all other non-structural components shall be supported and anchored in place by methods that satisfy the building code and the Contract Documents.

c. All equipment and all other non-structural components shall be supported and anchored in place by methods that satisfy the manufacturer's applicable seismic certification requirements.

2. Component attachments shall be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.

B. Non-Building Structures

1. Non-Building Structures shall be designed in accordance with ASCE 7 Chapter 15.

2. Non-Building Structures, foundations, supports, anchors, and restrainers shall be adequately designed for all applicable static, dynamic, operational, seismic loads.

3. Friction shall not be used to resist sliding due to seismic forces, except as indicated below:

a. Friction may be used to resist sliding of Welded or Bolted Steel Tanks designed in accordance with AWWA D100 or AWWA D103, respectively, when specifically permitted by that Standard.

C. Anchors – General

1. Anchor bolts shall be in accordance with Section 055000.

2. Grouts for anchor bolts shall be in accordance with Section 036000.

3. The Contractor shall determine the size, type, capacity, location, and other placement requirements of anchorage elements. Anchoring methods and leveling criteria in the manufacturer's literature shall be followed. Submit methods and criteria with the calculations and details.

4. Anchor bolt calculations shall clearly show that the capacity of the anchor and the capacity of the concrete that the anchor is embedded in are adequate to resist all applicable load combinations, including seismic loads.

    a. The design of anchors resisting seismic forces shall satisfy the ductility requirements stated in the IBC, ASCE 7, ACI 318, and ACI 530.

5. Reduction factors associated with edge distance, embed length, grout and base plate thickness, and bolt spacing shall all be considered and based on the actual dimensions of the concrete or masonry that resists the anchorage forces.

6. Where anchorage is required into or through equipment pads, the following requirements shall apply unless otherwise approved by the Engineer:

    a. For tensile forces, the embed length and associated concrete failure zone shall be provided entirely within the structural slab. No portion of the equipment pad may be considered as effective in resisting tensile forces.

    b. For shear forces, the edge distance and associated concrete failure zone shall be provided entirely within the equipment pad. No portion of the structural slab may be considered as effective in resisting shear forces.

7. Anchor bolt details shall include required bolt diameter, embed, spacing, and edge distances.

8. Where additional reinforcement is required to satisfy anchorage requirements, such reinforcement shall be included in the anchorage details, and shall be furnished and installed by the Contractor.

D. Mechanical and Electrical Equipment Foundations

1. Equipment foundations are indicated on Drawings. The Contractor, through the equipment manufacturer, shall verify the size and weight of the equipment foundation to ensure compatibility with equipment.

2. Equipment foundation dimensions shall be coordinated with the equipment base geometry and the edge distance and embed requirements of the equipment anchorage calculations.

E. Mechanical and Electrical Equipment (Housekeeping) Pads

1. General

    a. Equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on concrete equipment pads, unless otherwise indicated. The top surface of the equipment pads shall be level, unless otherwise indicated, or otherwise required by the equipment manufacturer.

    b. Equipment pads shall be sized to accommodate the bearing and anchorage requirements of the equipment, subject to the constraints listed below.

c. Final geometry of the equipment pads shall not result in a condition that violates applicable building code provisions, including but not limited to the provisions of the National Electric Code.

2. Mechanical Equipment Pads

a. Mechanical equipment pad heights shall be coordinated with process equipment and piping elevation requirements. Where no such elevation constraints exist, the equipment pad height shall be as shown on the drawings, or as indicated below when no specific height is provided.

1) Equipment pads for mechanical equipment shall be 3.5 inches tall (maximum) at the front of the equipment.

b. Mechanical equipment pads shall extend not more than 2 inches beyond the front, back, and sides of the equipment, except as indicated below, unless otherwise shown on the drawings.

1) Where necessary to meet seismic anchorage requirements, the pads may be extended beyond the 2 inch limit indicated above. The pads shall extend not more than 6 inches beyond the front, back, and sides of the equipment.

3. Electrical Equipment Pads

a. Electrical equipment pads shall be 3.5 inches tall (maximum) at the front of the equipment.

b. Electrical equipment pads shall extend not more than 2 inches beyond the front, back, and sides of the equipment, except as indicated below, unless otherwise shown on the drawings.

1) Where necessary to meet seismic anchorage requirements, the pads may be extended beyond the 2 inch limit indicated above. The pads shall extend not more than 6 inches beyond the front, back, and sides of the equipment.

- END OF SECTION -

SECTION 01 50 10 – TEMPORARY BYPASS PUMPING SYSTEM

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The Contractor shall provide labor, supervision, tools and equipment necessary to deliver, install, remove and demobilize a Temporary Bypass Pumping System as described in this specification. The purpose of the Temporary Bypass Pumping System is to provide firm pumping capacity for influent sewage flow to the Kellogg Creek Influent Pump Station if one of the large 14 mgd pumps out of service during the wet season (Oct 1st to May 31st). At the OWNERS discretion, bypass pumping may be required beyond May 31st.

B. Temporary Bypass Pumping System requires the installation and operation of piping, hoses, valves, trailer mounted diesel engine driven pumps, and flow meters.

C. Refer to Section 01 14 00 – Construction Constraints for the project constraints and sequence and scheduling of work which dictate whether or not the Temporary Bypass Pumping System is required. If required, the Temporary Bypass Pumping System is expected to operate continuously 24 hrs per day, 7 days per week for the duration of the WORK, and Contractor is responsible for operation of the Temporary Bypass Pumping System and coordination with the Owner.

D. The upstream and downstream pipeline (including all piping, valves and appurtenances), to which the Temporary Bypass Pumping System connects, is to be hydrostatically pressure tested prior to operation of the Temporary Bypass Pumping System.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Submittal Procedures and the following.

1. Provide a written plan/sketch for implementation and sequencing of the Temporary Bypass Pumping System for review and approval of the Engineer prior to installation of the bypass pumps. The plan shall include sufficient detail to show the location, number and size of pumps, hoses/rigid piping, and location of the upstream and downstream connection points.

2. Provide delivery, installation and test schedule of the Temporary Bypass Pumping System.

3. Project information including project name and location.

4. Pump manufacturer, model and hydraulic performance curve showing flow, head, efficiency and brake horsepower, NPSHR, and absorbed horsepower for speeds from minimum to maximum.

5. Contact information for Temporary Bypass Pumping System supplier, including company name, contact person (24 hours per day) and phone number.

6. Length, size, material, location of the suction and discharge piping.

7. Size and location of any temporary pipe supports.

8. Estimated fuel consumption.

9. Recommended maintenance schedule

10. Operation plan for anticipated duration of WORK

11. Emergency cleanup plan

1.3 DELIVERY AND STORAGE

A. The Contractor shall coordinate the delivery and work schedule with the Temporary Bypass Pumping System Supplier.

B. The Temporary Bypass Pumping System Supplier shall transport, deliver, handle and store pipe, fittings, pumps, ancillary equipment, and materials to prevent damage following Manufacturer's recommendations. The Supplier shall inspect all material and equipment for proper operation before initiating work.

PART 2 -- PRODUCTS

2.1 GENERAL DESCRIPTION

A. The Temporary Bypass Pumping System shall consist of an arrangement of equipment, components, piping, hoses, wiring and ancillary components to connect to existing piping and form a functional, operational, safe and independent system to convey raw wastewater from the Influent Pump Station into the treatment influent channel, upstream of the screening facility. The Temporary Bypass Pumping System shall provide capacity to convey 14 mgd of flow, resulting in firm pumping capacity of 26 mgd to convey influent raw sewage.

B. The Supplier shall have a minimum of 5 years of experience in the design, application, and supply of municipal sewage bypass pumping systems.

C. The Temporary Bypass Pumping System shall include, but is not limited to:

1. Main Pumps

2. Diesel Drivers with Fuel Tank

3. Control Valves

4. Piping

5. Flexible Hoses and Associated Couplings and Connectors

6. Valves and Fittings

7. Instrumentation and Monitoring Equipment

8. Local Controls

D. The pump and bypass pumping lines shall be of adequate capacity and size to handle the peak flow conditions. All piping, joints and accessorizes shall be designed to withstand the pump shut off head.

E. Operating Conditions: The Work of this Section shall be suitable for long term operation under the conditions as indicated in Section 2.3 of this Specification Section.

F. Performance Requirements: The Work of this Section shall meet the performance requirements as indicated in Section 2.3 of this Specification Section.

G. Pipeline Connection Dimensions: The bypass pumping system shall be designed to connect to the upstream and downstream bypass connections points as indicated in Section 2.3 of this Specification Section.

2.2 TEMPORARY BYPASS PUMPING SYSTEM REQUIREMENTS

A. Main Pumps: Pumps shall be trailer mounted, fully automatic, self-priming and in good working order with a working pressure gauge on the discharge.

B. Diesel Drives with Fuel Tank: Pumps shall be driven by a diesel engine with a 16-hour minimum capacity fuel tank. In addition, the diesel engine shall be provided with a 780 gallon fuel cell. Diesel engines shall not produce noise levels exceeding 70 dBA at a distance of 10 feet from the source or the property line of the facility, whichever is closer. Sound attenuating enclosures should be provided as required.

C. Controls: Supplier shall provide the necessary control to allow for input of an operator specified flow set point. Flowmeter shall be provided to measure pumped flow.

D. Piping: High-Density Polyethylene (HDPE)

1. Homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, blisters, or other deleterious faults.

2. Assembled and jointed at site using couplings, flanges or butt-fusion method to provide leak proof joint. Follow Manufacturer's instructions and ASTM D2657. Threaded or solvent joints and connections are not permitted.

3. Fusing shall be personnel certified as fusion technicians by Manufacturer of HDPE pipe and/or fusing equipment.

4. Butt-fused joint: True alignment and uniform roll-back beads resulting from use of proper temperature and pressure.

a. Allow adequate cooling time before removal of pressure pipe.

b. Watertight and have tensile strength equal to that of pipe.

c. Acceptance by Engineer before insertion.

E. Flexible Hoses and Associated Couplings and Connectors.

1. Abrasion resistant

2. Suitable for intended service.

3. Rated for external and internal loads anticipated, including test pressure.

F. Valves and Fittings: Determined according to flow calculations, pump sizes previously determined and system operating pressures.

G. Instrumentation and Monitoring: System shall include pressure gauges, flow meters and alarms. Flow meter shall be a wireless gauge that provides remote monitoring of flow in real time and from a centralized location or mobile device. Flow meter shall be a RiteFlo® Gauge or Equal.

2.3 PERFORMANCE REQUIREMENTS

A. **Operating Conditions:** The Work of this Section shall be suitable for long term operation under the following conditions:

Duty	Continuous
Drive	Diesel Engine
Ambient environment	Outdoors
Ambient temperature, degrees F	20 to 88
Fluid service	Raw Unscreened Waste Water
Fluid temperature, degrees F	38 to 60
Fluid pH range	4 to 9
Fluid specific gravity	1.0
Project site elevation, msl	25.0
Minimum available NPSH	Pump to be Dri-Prime type

B. Performance Requirements:

TOTAL Design Flow: flow capacity, (MGD)@ TDH (ft.)	14 MGD @ 60 ft
Maximum shutoff head, ft @ 1,780 RPM	120
No. of Pumps	Per Mfr's Recommendation
Flow Capacity per Pump	Per Mfr's Recommendation
Design Pump speed, rpm	Per Mfr's Recommendation
Suction Condition	Flooded

C. Pipeline Connection Dimensions:

1. Bypass pumping supply shall review the site plan to determine exact length of pipe required between the upstream and downstream connection points.

Upstream Connection Size, (inches)	18, Supplier to Confirm
Downstream Connection Size, (inches)	18, Supplier to Confirm

2.4 SUPPLIERS OR EQUAL

A. RainforRent

PART 3 -- EXECUTION

3.1 SERVICES OF SUPPLIER

A. The contractor shall notify the Owner at least 7 days in advance of implementing bypass pumping.

B. Installation Supervision: The service representative of the Supplier shall be continuously present at the Site during the installation of the equipment and piping. The number of days shall be mutually determined by the Supplier and the Contractor.

C. Installation of temporary bypass pumping system shall not cause property damage, restrict site access, or prevent access to equipment or unaffected Work areas.

D. The Contractor shall be required to demonstrate that the pumping system is in good working order and is sufficiently sized to successfully handle flows by performing a test run for a period of 24 hours prior to beginning the Work.

E. Instruction of Owner's Personnel: The training representative of the Supplier shall be present at the Site for a minimum of 1 Day to furnish training or maintenance, operation and controls.

F. For the purposes of this paragraph, a Day is defined as an 8 hour period at the Site, excluding travel time.

G. The Engineer may require that the inspection, startup, and field adjustment services above be furnished in two separate trips.

END OF SECTION

SECTION 01 50 20 - PROTECTION OF EXISTING FACILITIES

PART 1 -- GENERAL

1.1 GENERAL

A. The CONTRACTOR shall protect all existing utilities and improvements during set-up, and removal of the temporary bypass pumping system. CONTRACTOR shall restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation, all in accordance with the Contract Documents.

1.2 RIGHTS-OF-WAY

A. The CONTRACTOR shall not do any WORK that would affect any oil, gas, sewer, or water pipeline; any telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall the CONTRACTOR enter upon the rights-of-way involved until notified that the OWNER has secured authority therefor from the proper party.

B. After authority has been obtained, the CONTRACTOR shall give said party due notice of its intention to begin work, if required by said party, and shall remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

1.3 PROTECTION OF STREET OR ROADWAY MARKERS

A. The CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by the CONTRACTOR shall be accurately restored after street or roadway resurfacing has been completed.

1.4 RESTORATION OF PAVEMENT

A. General: All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement.

B. Permanent Resurfacing: In order to obtain a satisfactory junction with adjacent surfaces, the CONTRACTOR shall saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

C. Restoration of Sidewalks or Private Driveways: Wherever sidewalks or private roads have been damaged during construction, the CONTRACTOR shall place suitable temporary sidewalks or roadways promptly after backfilling and shall maintain them in satisfactory condition for the period of time fixed by the authorities having jurisdiction over the affected

portions. If no such period of time is so fixed, the CONTRACTOR shall maintain said temporary sidewalks or roadways until the final restoration thereof has been made.

1.5 EXISTING UTILITIES AND IMPROVEMENTS

A. General: The CONTRACTOR shall protect underground Utilities and other improvements which may be impaired during construction operations, regardless of whether or not the Utilities are indicated on the Drawings. The CONTRACTOR shall take all possible precautions for the protection of unforeseen Utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

B. Utilities to be Moved: In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the CONTRACTOR, be notified by the OWNER to move such property within a specified reasonable time. When utility lines that are to be removed are encountered within the area of operations, the CONTRACTOR shall notify the ENGINEER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

C. Utilities to be Removed: Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, the CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to the ENGINEER and the owner of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by the CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

D. OWNER's Right of Access: The right is reserved to the OWNER and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the WORK of this Contract.

E. Underground Utilities Indicated: Existing Utility lines that are indicated or the locations of which are made known to the CONTRACTOR prior to excavation and that are to be retained, and all Utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the CONTRACTOR, unless otherwise repaired by the owner of the damaged Utility. If the owner of the damaged facility performs its own repairs, the CONTRACTOR shall reimburse said owner for the costs of repair.

F. Underground Utilities Not Indicated: In the event that the CONTRACTOR damages existing Utility lines that are not indicated or the locations of which are not made known to the CONTRACTOR prior to excavation, a verbal report of such damage shall be made immediately to the ENGINEER and a written report thereof shall be made promptly thereafter. The ENGINEER will immediately notify the owner of the damaged Utility. If the ENGINEER is not immediately available, the CONTRACTOR shall notify the Utility owner of the damage. If directed by the ENGINEER, repairs shall be made by the CONTRACTOR under the provisions for changes and extra work contained in Articles 10, 11, and 12 of the General Conditions.

G. Costs of locating and repairing damage not due to failure of the CONTRACTOR to exercise reasonable care, and removing or relocating such Utility facilities not indicated in

the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the WORK which was interrupted or idled by removal or relocation of such Utility facilities, and which was necessarily idled during such work will be paid for as extra work in accordance with the provisions of Articles 10, 11, and 12 of the General Conditions.

H. Approval of Repairs: All repairs to a damaged Utility or improvement are subject to inspection and approval by an authorized representative of the Utility or improvement owner before being concealed by backfill or other work.

I. Maintaining in Service: Unless indicated otherwise, oil and gasoline pipelines, power, and telephone or the communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the WORK shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the ENGINEER are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable. The CONTRACTOR shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.6 LAWN AREAS

A. Lawn or landscaped areas damaged during construction shall be repaired to match the pre-construction condition to the satisfaction of the land owner and the OWNER.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

END OF SECTION

SECTION 01 60 00 - PRODUCTS, MATERIALS, EQUIPMENT, AND SUBSTITUTIONS

PART 1 - GENERAL

1.1 DEFINITIONS

A. The word "Products," as used in the Contract Documents, is defined to include purchased items for incorporation into the WORK, regardless of whether specifically purchased for the project or taken from CONTRACTOR's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form WORK. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying, and erection of the WORK.

1.2 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of WORK, the CONTRACTOR shall provide products, materials, and equipment of a singular generic kind from a single source.

B. Compatibility of Options: Where more than one choice is available as options for CONTRACTOR's selection of a product, material, or equipment, the CONTRACTOR shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.3 PRODUCT DELIVERY AND STORAGE

A. The CONTRACTOR shall deliver and store the WORK in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at the Site and overcrowding of construction spaces. In particular, the CONTRACTOR shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

1.4 TRANSPORTATION AND HANDLING

A. Products shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.

B. The CONTRACTOR shall provide equipment and personnel to handle products, materials, and equipment [including those furnished by OWNER,] by methods to prevent soiling and damage.

C. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.5 STORAGE AND PROTECTION

A. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.

B. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.

C. Storage shall be arranged to provide access for inspection. The CONTRACTOR shall periodically inspect to assure products are undamaged and are maintained under required conditions.

D. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.6 MAINTENANCE OF PRODUCTS IN STORAGE

A. Stored products shall be periodically inspected on a scheduled basis. The CONTRACTOR shall maintain a log of inspections and shall make the log available on request.

B. The CONTRACTOR shall comply with manufacturer's product storage requirements and recommendations.

C. The CONTRACTOR shall maintain manufacturer-required environmental conditions continuously.

D. The CONTRACTOR shall ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.

E. For mechanical and electrical equipment, the CONTRACTOR shall provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.

F. Products shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to final acceptance by the OWNER in accordance with the Contract Documents.

1.7 PROPOSED SUBSTITUTIONS OR "OR-EQUAL" ITEM

A. Pump substitution is not allowed, see Section 43 25 06 – Dry Pit Submersible Solids Handling Pumps.

B. Whenever materials or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular manufacturer, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other manufacturers may be accepted if sufficient information is submitted by the

CONTRACTOR to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:

1. The burden of proof as to the type, function, and quality of any such substitution product, material or equipment shall be upon the CONTRACTOR.

2. The ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and the ENGINEER's decision shall be final.

3. The ENGINEER may require the CONTRACTOR to furnish additional data about the proposed substitution.

4. The OWNER may require the CONTRACTOR to furnish a special performance guarantee or other surety with respect to any substitution.

5. Acceptance by the ENGINEER of a substitution item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substitution.

6. The CONTRACTOR shall pay all costs of implementing accepted substitutions, including redesign and changes to WORK necessary to accommodate the substitution.

C. The procedure for review by the ENGINEER will include the following:

1. If the CONTRACTOR wishes to provide a substitution item, the CONTRACTOR shall make written application to the ENGINEER on the "Substitution Request Form."

2. Unless otherwise provided by law or authorized in writing by the ENGINEER, the "Substitution Request Form(s)" shall be submitted within the 35-day period after award of the Contract.

3. Wherever a proposed substitution item has not been submitted within said 35-day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by the ENGINEER, the CONTRACTOR shall provide the material or equipment indicated in the Contract Documents.

4. The CONTRACTOR shall certify by signing the form that the list of paragraphs on the form are correct for the proposed substitution.

5. The ENGINEER will evaluate each proposed substitution within a reasonable period of time.

6. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized without the ENGINEER'S prior written acceptance of the CONTRACTOR'S "Substitution Request Form."

7. The ENGINEER will record the time required by the ENGINEER in evaluating substitutions proposed by the CONTRACTOR and in making changes by the CONTRACTOR in the Contract Documents occasioned thereby.

D. The CONTRACTOR's application shall address the following factors which will be considered by the ENGINEER in evaluating the proposed substitution:

1. Whether the evaluation and acceptance of the proposed substitution will prejudice the CONTRACTOR's achievement of Substantial Completion on time.

2. Whether acceptance of the substitution for use in the WORK will require a change in any of the Contract Documents to adapt the design to the proposed substitution.

3. Whether incorporation or use of the substitution in connection with the WORK is subject to payment of any license fee or royalty.

4. Whether all variations of the proposed substitution from the items originally specified are identified.

5. Whether available maintenance, repair, and replacement service are indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.

6. Whether an itemized estimate is included of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.

7. Whether the proposed substitute item meets or exceeds the experience and/or equivalency requirements listed in the appropriate technical specifications.

E. Without any increase in cost to the OWNER, the CONTRACTOR shall be responsible for and pay all costs in connection with proposed substitutions and of inspections and testing of equipment or materials submitted for review prior to the CONTRACTOR's purchase thereof for incorporation in the WORK, whether or not the ENGINEER accepts the proposed substitution or proposed equipment or material. The CONTRACTOR shall reimburse the OWNER for the charges of the ENGINEER for evaluating each proposed substitution.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 75 00 – EQUIPMENT TESTING AND PUMP STATION STARTUP

PART 1 - GENERAL

1.1 THE SUMMARY

A. Pump Station startup is prerequisite to satisfactory completion of the contract requirements and shall be completed within the Contract Times.

B. Conduct all test, check out, startup, and related requirements indicated in the Contract Documents and provide documentation of same to the ENGINEER prior to requesting Substantial Completion from the ENGINEER. Where manufacturer onsite inspections are required before startup, the manufacturer shall furnish a written statement that the installation and check out is complete and proper and that the item(s) are ready for startup

C. Startup of a pump station is a highly complex operation requiring the combined expertise of the CONTRACTOR, Subcontractors, the ENGINEER, and the OWNER. The CONTRACTOR shall be responsible for coordinating all parties for a successful startup: the ENGINEER and OWNER will be available for technical and operational advice prior to and during startup.

D. General requirements for startup activities are included in this Section. More specific requirements may also be included in other portions of the Contract Documents.

E. Temporary facilities may be necessary to keep wastewater flowing through the pump station as pumps are taken off-line for replacement. If so, CONTRACTOR shall design, provide, operate, and later decommission them.

1.2 DEFINITIONS

A. Startup is defined as testing, demonstrations, and other activities as required to achieve Substantial Completion. Startup includes pre-commissioning and commissioning activities, manufacturer's services, certifications of readiness for testing, and troubleshooting, checkout, and shakedown activities.

B. Pre-commissioning is the systematic demonstration through testing and extended operation that major equipment and auxiliary systems, including related components, sub-systems, and systems operate properly and consistent with their intended function. Pre-commissioning involves balancing, adjustments, calibration, loop checks, and loop validation. Pre-commissioning shall simulate shutdown conditions, failure conditions, power fail and restart, bypass conditions, and failure resets. Pre-commissioning will not be considered complete until successful results and documentation of tests and manufacturer's certifications required by the Contract Documents are submitted and accepted by the ENGINEER. Pre-commissioning of all portions of the WORK shall be successfully completed prior to starting Commissioning.

C. Commissioning is the verification that the complete WORK functions on an extended basis in full conformance with the Contract requirements.

1.3 SUBMITTALS

A. Schedule: The schedule for startup shall be submitted within Construction Schedule.

B. Startup Plan: Not less than 60 Days prior to startup, submit for review a detailed Startup Plan. The CONTRACTOR shall revise the Plan as necessary based on review comments. The Plan shall include:

1. Schedules for manufacturers' equipment certifications

2. Schedules for submitting final Technical Manuals,

3. Schedule for training the OWNER's personnel,

4. Description of temporary facilities and schedule for installation and decommissioning them

5. List of OWNER and CONTRACTOR-furnished supplies

6. Detailed schedule of operations to achieve successful pre-commissioning and commissioning.

7. Checklists and data forms for each item of equipment

8. Address coordination with the OWNER's staff.

9. Designate a representative of the CONTRACTOR who has the authority to act in matters relating to startup and has experience in testing medium or large sized pump stations and pipelines. The Plan shall also designate the roles and responsibilities of any Subcontractors that may be involved in startup activities.

10. Safety, startup, and testing procedures and proposed inspection and certification forms and records.

11. Interconnection of new to existing facilities

    a. Date and time frame of proposed shutdown or interconnection, including sequence of events and activities to be conducted.

    b. A detailed description of sequences and activities for the planned shutdown and interconnection.

    c. Staff, equipment, and materials that will be at the Site before commencing the shutdown.

    d. Other provisions so that interconnection, testing, and startup will be completed within the planned time.

12. Hydrostatic testing of water-holding structures and pipelines and other potable water equipment. Schedule and plan shall indicate source of water, testing and disinfection sequence, disinfection procedures, and the disposal of the water following disinfection.

C. System Outage Requests: Request for shutdown of existing systems as necessary to test or start up new facilities.

D. Records and Documentation

1. Where required by the specifications, submit equipment installation certifications under those Sections.

2. Records of startup as indicated below.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 MALFUNCTIONS

A. During the extended operational demonstrations, all components, subsystems, systems, and equipment must properly run continuously 24 hours per day at rates indicated by the ENGINEER throughout the test period. Unless indicated otherwise, if any item fails or malfunctions during the test, the item shall be repaired and the test restarted at time zero with no credit given for the operating time before the failure or malfunction. Malfunctions satisfying all 3 of the following conditions will allow the demonstration period to resume at the elapsed time when the malfunction started:

1. Malfunction did not cause any interruption of the continuous operation of any other components, subsystems, systems, and equipment.

2. Malfunction was corrected without causing or requiring any components, subsystems, systems, and equipment to cease operations.

3. Malfunction was corrected within one hour of the time the malfunction was detected (the one-hour period includes the time required to locate the cause of the malfunction, beginning upon CONTRACTOR’s notification from the ENGINEER that a malfunction has occurred and ending when the item is corrected and the system is successfully placed back into operation).

B. The CONTRACTOR shall arrange for manufacturer's representatives to visit the Site as often as necessary to correct malfunctions.

3.2 PREREQUISITES

A. Pre-commissioning and commissioning activities shall be scheduled according to the CPM Construction Schedule. The 7 Day demonstrations and the 8 Day demonstration shall start prior to midday on a Monday, Tuesday, or Wednesday. Testing periods shall not include holidays, based on the OWNER's calendar.

B. The following shall be completed before pre-commissioning begins.

1. All Technical Manual information required by the Contract Documents has been submitted.

2. Safety equipment, emergency shower and eyewash units, fire extinguishers, gas detectors, protective guards and shields, emergency repair kits, safety chains, handrails, gratings, safety signs, and valve and piping identification required by the Contract Documents are provided. Devices and equipment shall be fully functional, adjusted, and tested.

3. Manufacturer's certifications of proper installation have been accepted.

4. Leakage tests, electrical tests, and adjustments have been completed.

5. The ENGINEER has approved the Startup Plan.

6. Temporary facilities are functional, adjusted, and ready for use.

7. Individual instrumentation loops (analog, status, alarm, and control) have been verified functionally.

8. Pressure switches, flow switches, timing relays, level switches, vibration switches, temperature switches, RTD monitors, pressure regulating valves, and other control devices to the settings determined by the ENGINEER or the equipment manufacturer have been adjusted for accuracy.

9. Individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls have been verified.

3.3 GENERAL

A. Supplies

1. The CONTRACTOR shall furnish:

a. Water

b. Power

c. Chemicals

d. Fuel

e. Oil and grease

f. Other necessary materials not listed for the OWNER to furnish

2. The OWNER will furnish:

a. Wastewater

B. Startup Records: The CONTRACTOR shall maintain the following during testing and startup and submit originals to ENGINEER:

1. Lubrication and service records for each mechanical and electrical equipment item

2. Hours of daily operation for each mechanical and electrical equipment item

3. Equipment alignment and vibration measurement records

4. Logs of electrical measurements and tests

5. Instrumentation calibration and testing logs

6. Testing and validation of SCADA inputs, outputs, logic functions, status indications, and alarms

7. Factory and field equipment settings

8. Log of problems encountered and remedial action taken

9. Other records, logs, and checklists as required by the Contract Documents

3.4 PRE-COMMISSIONING

A. After individual equipment items and subsystems have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. Items of equipment shall be tested as part of a system to the maximum extent possible.

B. Subject to the malfunction criteria above, each system shall be demonstrated for a continuous, 7 Day, 24 hour/day period. If any system malfunctions, the item or equipment shall be repaired and the test restarted at time zero with no credit given for the elapsed time before the malfunction.

C. The CONTRACTOR shall demonstrate the manual and automatic modes of operation to verify proper control sequences, software interlocks, proper operation of software logic and controllers, etc. System testing shall include the use of water or other process media, as applicable, to simulate the actual conditions of operation.

D. Systems testing activities shall follow the detailed procedures and checklists in the Testing and Startup Plan. Completion of systems shall be documented by a report.

E. The CONTRACTOR shall demonstrate utility, chemical feed, safety equipment, and other support systems before whole process systems.

F. Furnish the ENGINEER at least 10 Days written notice confirming the start of pre-commissioning. The OWNER's staff will observe pre-commissioning.

3.5 COMMISSIONING

A. The CONTRACTOR shall start up each pump and operate it without malfunction for a continuous 8 Day, 24 hour/day period. The ENGINEER will determine the operational parameters.

B. Defects that appear shall be promptly corrected. Time lost for wiring corrections, control point settings, or other reasons that interrupt the test may, at the judgement of the ENGINEER, be cause for extending the demonstration an equal amount of time.

C. Commissioning shall not begin until leakage tests, instrumentation tests and adjustments, electrical tests and adjustments, equipment field tests, disinfection, and system tests have been completed to the satisfaction of the ENGINEER.

D. Detail Requirements: Prior to starting the performance test, pump may be supplied with clean water to demonstrate satisfactory operation if requested by pump supplier and coordinated by CONTRACTOR. Once satisfactory operation is confirmed, the 8 Day commissioning test shall be performed with raw wastewater from the existing wastewater pump station/collection system. The Contractor is responsible for temporary test piping configurations and ensuring all wastewater and any overflows contained within the pump station and treatment plant.

E. The OWNER will furnish certified pump station operators during the startup period to comply with Environmental Quality requirements. Certified operators will be under the direct supervision of and be responsible to the CONTRACTOR. The CONTRACTOR shall furnish continuous, 24 hour staffing at the facility.

F. During commissioning, the CONTRACTOR shall:

1. Lubricate and maintain equipment in accordance with the manufacturers' recommendations.

END OF SECTION

SECTION 01 77 00 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 FINAL CLEANUP

A. The CONTRACTOR shall promptly remove from the vicinity of the completed WORK, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the OWNER will be withheld until the CONTRACTOR has satisfactorily performed the final cleanup of the Site.

1.2 CLOSEOUT TIMETABLE

A. The CONTRACTOR shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the OWNER, the ENGINEER, and their authorized representatives sufficient time to schedule attendance at such activities.

1.3 TECHNICAL MANUAL SUBMITTAL

A. The CONTRACTOR's attention is directed to the condition that [one] percent of the Contract Price will be retained from any monies due the CONTRACTOR as progress payments, if at the 75 percent construction completion point, the approved Technical Manual complying with Section 01 33 00 – Contractor Submittals has not been submitted. The aforementioned amount will be retained by the OWNER as the agreed, estimated value of the approved Technical Manual. Any such retention of money for failure to submit the approved Technical Manual on or before the 75 percent construction completion point shall be in addition to the retention of any payments due to the CONTRACTOR under Article 14 of the General Conditions.

1.4 FINAL SUBMITTALS

A. The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the ENGINEER for transmittal to the OWNER:

1. Written guarantees, where required.

2. Technical Manuals and instructions.

3. New permanent cylinders and key blanks for all locks.

4. Maintenance stock items; spare parts; special tools.

5. Completed record drawings.

6. Bonds for roofing, maintenance, etc., as required.

7. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

8. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.5 MAINTENANCE AND GUARANTEE

A. The CONTRACTOR shall comply with the maintenance and guarantee requirements contained in Article 13 of the General Conditions.

B. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the CONTRACTOR fails to make such repairs or replacements promptly, the OWNER reserves the right to do the WORK and the CONTRACTOR and its surety shall be liable to the OWNER for the cost thereof.

1.6 BOND

A. The CONTRACTOR shall provide a bond to guarantee performance of the provisions contained in Paragraph "Maintenance and Guarantee" above, and Article 13 of the General Conditions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 79 00 - OWNER STAFF TRAINING

PART 1 - GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall furnish all labor, materials, equipment, and incidentals necessary to train OWNER's personnel on the equipment, products, and systems furnished under this Contract. OWNER training is a prerequisite to satisfactory completion of the Contract requirements and shall be completed within the Contract Time.

B. The minimum onsite training requirements for various plant components are described in various sections of the specifications.

C. Except where otherwise indicated, all costs for training shall be the responsibility of the CONTRACTOR.

1.2 SUBMITTALS

A. Training Schedule: Schedule for training the OWNER's personnel shall be submitted with the detailed Testing and Startup Plan required by Section 01 75 00 – Equipment Testing and Pump Station Startup.

B. Training shall be provided by a factory authorized Flygt Equipment Manufacturer.

C. The training lesson plan and materials shall be submitted to the ENGINEER for review.

D. Approved operation and maintenance manuals shall be available at least 30 days prior to the scheduled date for the individual training session.

E. A single training class shall be scheduled a minimum of four (4) weeks in advance of the date of the first class to allow OWNER staffing arrangements to take place. The CONTRACTOR shall coordinate with the OWNER to schedule a training class which meets the OWNERS requirements.

F. The training class shall consist of:

1. Safety to be conducted by the plant safety officer.

2. Overview of the startup system.

3. Training on each item of equipment within the startup system, conducted by the Equipment Manufacturer's representative.

4. Training on the mechanical piping system within the startup system, conducted by the CONTRACTOR'S mechanical superintendent.

5. Training on the power distribution system within the startup system, conducted by the CONTRACTOR'S electrical superintendent.

6. Training on the instrumentation and control systems within the startup system, conducted by the CONTRACTOR'S I&C System Supplier, Portland Engineering, Inc.

7. Training on the SCADA control system within the startup system, conducted by the Portland Engineering, Inc.

G. Within ten (10) days after the completion of each training session, the CONTRACTOR shall submit the following:

1. A sign-in sheet of all personnel that attended the training session.

2. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.

1.3 INSTRUCTOR QUALIFICATIONS

A. Instructors shall be completely knowledgeable in the products and systems for which they are providing training, and shall be experienced in conducting classes. Sales representatives are not considered qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.

B. Instructor shall have at least two years of experience in providing training certified by the Manufacturer.

C. If, in the opinion of the OWNER, the Instructor did not provide the scheduled training, such training shall be rescheduled and repeated with a suitable instructor at the CONTRACTOR's expense.

PART 2 - PRODUCTS

2.1 GENERAL

A. Where specified, the CONTRACTOR shall conduct training sessions for the OWNER's personnel to instruct the staff on the proper operation, care, and maintenance of the equipment and systems installed under this Contract.

2.2 TRAINING AIDS

A. Each instructor is encouraged to use audio-visual devices, P&IDs, models, charts, or other means to effectively increase the transfer of knowledge. The instructor conducting the training shall furnish all such equipment (televisions, CD/DVD recorder/player, projectors, screens easels, etc.), models, and charts for each class. It shall be the responsibility of the instructor to confirm in advance that the class room will be appropriate for the types of audio-visual equipment to be employed.

2.3 LOCATION

A. Training sessions shall take place at the project location.

2.4 FORMAT AND CONTENT

A. Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system. As a minimum, training session shall cover the following subjects for each item of equipment or system:

1. Familiarization

a. Review catalog, parts lists, drawings, etc., which have been previously provided for the OWNER’s files and operation and maintenance manuals.

b. Inspection on how the equipment has been installed. Demonstrate the operation of the unit and describe how all parts of the equipment meet the requirement of the Specifications.

c. Answer questions.

2. Safety

a. Using material previously provided, review safety features of the equipment.

b. Discuss proper precautions when working around equipment.

3. Operation

a. Using material previously provided, review reference literature.

b. Explain all modes of operation (including emergency).

c. Check out OWNER's personnel on proper use of the equipment.

4. Preventive Maintenance

a. Using material previously provided, review preventive maintenance (PM) lists including:

1) Reference material.

2) Daily, weekly, monthly, quarterly, semiannual, and annual PM activities.

b. Demonstrate how to perform Preventive Maintenance procedures.

c. Demonstrate to the OWNER's personnel what to look for as indicators of potential equipment problems.

5. Corrective Maintenance

a. Identify possible problems.

b. Demonstrate how to perform repairs. Point out special problems.

c. Open up equipment and demonstrate O & M procedures, where practical.

6. Parts

a. Demonstrate the use of previously provided parts list and order parts.

b. Check over spare parts on hand. Make recommendations regarding additional parts that should be available.

7. Local Representatives

a. Identify local vendors where to order parts: name, address, telephone.

b. Service problems:

1) Identify contacts local contacts.

2) Identify emergency contacts.

8. Operation and Maintenance Manuals

a. Review any other material submitted.

b. Update material, as required.

PART 3 - EXECUTION

3.1 GENERAL

A. The objective of the training included under this Section shall be to convey the knowledge needed by the OWNER operations, maintenance, and engineering staff to safely operate, maintain, and repair the equipment and systems furnished under this CONTRACT.

B. OWNER personnel who will participate in this training have existing full-time work assignments and this training is an additional assigned work task. OWNER's staff work schedules regularly shift, as the plant is operated on an around-the-clock basis.

C. Training shall be tailored to suit the skills and job classifications of the personnel attending the classes e.g., plant manager, plant operator, maintenance technical, electrician, etc.

D. Minimum onsite training requirements for components are described in various sections of the Specifications. For the purpose of the times given in individual Specification sections, a workday is defined as an eight (8) hour day at the site, excluding travel time.

E. Training shall be scheduled as a separate trip from equipment inspection, startup, and field adjustment. Training shall not be done until the manufacturer certifies that the equipment is operable as specified.

F. Specific Training Objectives: The training shall include a review of the equipment and drives, including internal parts, as prepared at the factory. The training shall include safety, removal, inspection, cleaning, operation and maintenance of the equipment such as startup, normal operation and shutdown procedures, step-by-step troubleshooting procedures with all necessary test equipment, and emergency or abnormal operation procedures. Training shall include preventive maintenance and long-term maintenance procedures, special tools necessary, and a discussion of recommended spare parts.

END OF SECTION

SECTION 02 41 19 - DEMOLITION AND RECONSTRUCTION

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall demolish and reconstruct existing structural, architectural, mechanical, HVAC, electrical, and instrumentation facilities as indicated, in accordance with the Contract Documents.

1.2 COORDINATION

A. The CONTRACTOR shall carefully coordinate the WORK in areas where existing facilities are interconnected with new facilities and where existing facilities remain operational. The WORK as indicated is not all-inclusive, and the CONTRACTOR shall be responsible to perform the reconstruction indicated plus that which can be reasonably inferred from the Contract Documents as necessary to complete the Project. The Specifications and Drawings identify the major facilities that shall be demolished and reconstructed, but auxiliary utilities such as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily shown. The CONTRACTOR shall comply with sequencing requirements in Section 01 14 00 - Construction Constraints.

B. The CONTRACTOR shall note that the Drawings used to indicate demolition and reconstruction are based on record drawings of the existing facilities. These record drawings have been reproduced to show existing conditions and to clarify the scope of WORK as much as possible. Prior to Bidding, the CONTRACTOR shall conduct a comprehensive survey at the Site to verify the correctness and exactness of the Drawings, the scope of WORK, and the extent of auxiliary utilities. A complete set of record drawings is available for review at the Project site.

C. While demolition and reconstruction are being performed, the CONTRACTOR shall provide adequate access for the continued operation and maintenance of equipment and treatment processes. The CONTRACTOR shall erect and maintain fences, warning signs, barricades, and other devices around the reconstruction as required for the protection of the CONTRACTOR's employees and the OWNER's personnel at the plant. The CONTRACTOR shall remove such protection when reconstruction activities are complete, or as WORK progresses, or when requested by the ENGINEER.

1.3 CONTRACTOR SUBMITTALS

Demolition and reconstruction activities and procedures, including operational sequences, shall be submitted to the ENGINEER for approval. The procedures shall provide for safe conduct of the WORK, careful removal and disposition of materials and equipment, protection of existing facilities which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection and reconnection of utility services. The procedures shall include a detailed description and time schedule of the methods and equipment to be used for each operation and the sequence of operation. A storage plan for salvaged items shall be included.

1.4 DEMOLITION

A. Existing pavement, structures, equipment, piping, valves, ductwork, electrical gear, instrumentation, utilities, and related appurtenances such as anchors, supports, and

hardware indicated or required to be demolished as part of the WORK shall be removed and disposed of unless otherwise indicated. Removal of buried structures, utilities, and appurtenances includes the related excavation and backfill as required. Removed items shall be disposed of offsite by the CONTRACTOR.

B. Items to be removed include:

Item	Description
Pump suction and discharge piping	Steel and ductile iron
Wastewater Pumps No. 2 and No. 4	Pumps with shaft and motor
Pump and piping support pads	Concrete with rebar reinforcement
Outdoor transformer	Abandoned T-2 transformer located southeast of the pump station.

1.5 SALVAGE

A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances indicated to be salvaged shall be removed without any degradation in condition from that prior to removal. Salvaged items shall be stockpiled and protected on the Site at a location chosen by the ENGINEER. The CONTRACTOR shall be responsible to properly safeguard the salvaged items against damage and loss during removal and handling.

B. Items to be salvaged include:

Item	Description
VFD and control panels for P-2 and P-4	Palletize and shrink wrap VFDs for Owner transport.

1.6 ABANDONMENT

A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances to be abandoned shall be prepared by the CONTRACTOR as indicated.

B. Items to be abandoned include:

Item	Description
Seal water pumps and appurtenances	Remove piping to the extent shown on drawings

1.7 REHABILITATION

A. Existing structural, mechanical, HVAC, electrical, and instrumentation WORK disturbed or damaged by reconstruction activities shall be repaired and rehabilitated as indicated.

B. Damaged items shall be repaired or replaced with new items to restore items or surfaces to a condition equal to and matching that existing prior to damage.

C. The CONTRACTOR shall not use any OWNER equipment (e.g., bridge cranes and monorails) unless authorized in advance in writing by the ENGINEER. Such authorization shall be subject to documentation by the CONTRACTOR of the proposed load on the equipment and be subject to OWNER requirements for usage on operating and maintenance needs. Any damage to a crane shall be repaired or replaced to the ENGINEER's satisfaction.

1.8 DISPOSAL

A. The CONTRACTOR shall be responsible for the offsite disposal of debris resulting from reconstruction in compliance with local, state, and federal codes and requirements.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

A. The CONTRACTOR shall coordinate demolition and reconstruction WORK with the OWNER and ENGINEER. Unless otherwise indicated, the CONTRACTOR shall be responsible for the sequence of activities. WORK shall be performed in accordance with applicable safety rules and regulations.

B. The CONTRACTOR shall verify that any utilities connected to structures, equipment, and facilities to be removed, salvaged, replaced, or abandoned are rendered inoperable, replaced with new utilities, or adequately bypassed with temporary utilities before proceeding with demolition and reconstruction.

C. The CONTRACTOR shall take precautions to avoid damage to adjacent facilities and to limit the WORK activities to the extent indicated. If reconstruction beyond the scope indicated is required, the CONTRACTOR shall obtain approval from the ENGINEER prior to commencing.

3.2 PROTECTION OF EXISTING FACILITIES

A. Before beginning any reconstruction, the CONTRACTOR shall carefully survey the existing facilities and examine the Specifications and Drawings to determine the extent of reconstruction and coordination with the WORK. Existing facilities not subject to reconstruction shall be protected and maintained. Damaged existing facilities shall be repaired to the previous condition or replaced.

B. Persons shall be afforded safe passages around areas of demolition.

C. Structural elements shall not be overloaded. The CONTRACTOR shall be responsible for shoring, bracing, or adding new supports as may be required for adequate structural support as a result of WORK performed under this Section. The CONTRACTOR shall remove temporary protection when the WORK is complete or when so authorized by the ENGINEER.

D. The CONTRACTOR shall carefully consider bearing loads and capacities before placement of equipment and material on Site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the CONTRACTOR shall consult with the ENGINEER prior to the placement of such equipment or material.

3.3 DEMOLITION, SALVAGE, AND RELOCATION

A. The Contract Documents indicate existing facilities to be demolished, salvaged, and/or relocated. Auxiliary utilities including such services as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily indicated. The CONTRACTOR shall verify the scope of the WORK to remove the equipment indicated; coordinate its shutdown, removal, replacement, or relocation; and submit an outage plan in accordance with Section 01 14 00 - Construction Constraints. The removal of existing facilities for demolition, salvage, and relocation shall include the following requirements:

1. Equipment supports, including concrete pads, baseplates, mounting bolts, and support hangers, shall be removed. Damage to the existing structure shall be repaired as indicated.

2. Exposed piping including vents, drains, and valves shall be removed. Where exposed piping penetrates existing floors and walls, the piping, including wall thimbles, shall be removed to a minimum depth of 2-inches. Resultant openings in the structure shall be repaired as indicated.

3. Electrical control panels, junction boxes, motor control centers, and local switches and pushbuttons shall be removed.

4. Exposed electrical conduits and associated wiring shall be removed. Resultant openings in structures shall be repaired as indicated.

5. Connections to embedded electrical conduits shall be removed a minimum of 2-inches inside the finished surface of the existing structure. Wiring shall be removed and the resulting openings shall be repaired as indicated.

6. Associated instrumentation devices shall be removed.

7. Auxiliary utility support systems shall be removed.

8. The area shall be thoroughly cleaned such that little or no evidence of the previous equipment installation will remain.

9. When existing pipe is removed, the CONTRACTOR shall plug the resulting open ends whether or not so indicated. Where removed piping is exposed, the remaining piping shall be blind-flanged or fitted with a removable cap or plug.

10. When existing piping is removed from existing structures, the CONTRACTOR shall fill resulting openings in the structures and repair any damage such that the finished rehabilitated structure shall appear as a new homogeneous unit with little or no indication of where the new and old materials join. The openings in water-bearing structures shall be filled with non-shrink grout to be watertight and reinforced as required or indicated. In locations where the surface of the grout will be exposed to view, the grout shall be recessed approximately 1/2-inch and the recessed area filled with cement mortar grout.

11. Electrical reconstruction shall be conducted by the CONTRACTOR in a safe and proper manner to avoid injury from electrical shock to the OWNER's and CONTRACTOR's personnel. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable. At no time shall electrical wiring or connections which are energized or could become energized be accessible to CONTRACTOR, OWNER, or other personnel without suitable protection or warning signs.

B. The CONTRACTOR shall perform a functional test of existing equipment that is relocated and reinstalled to ensure the equipment functions in the manner documented during the initial inspection. The CONTRACTOR shall inform the ENGINEER in writing a minimum of 5 Days prior to the functional testing in order for the OWNER and ENGINEER to witness the test. If, in the opinion of the ENGINEER, the relocated equipment does not function in a satisfactory manner, the CONTRACTOR shall make repairs and modifications necessary to restore the equipment to its original operating condition at no additional cost to the OWNER.

3.4 REHABILITATION

A. Certain areas of existing structures, piping, conduits, and the like will be affected by WORK necessary to complete modifications under this Contract. The CONTRACTOR shall be responsible to rehabilitate those areas affected by its construction activities.

B. Where new rectangular openings are to be installed in concrete or concrete masonry walls or floors, the CONTRACTOR shall score the edges of each opening (both sides of wall or floor slab) by saw-cutting clean straight lines to a minimum depth of 1-inch and then chipping out the concrete. Alternately, the sides of the opening (not the corners) may be formed by saw cutting completely through the slab or wall. Saw cuts deeper than 1-inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling and chipping or grinding. Necessary precautions shall be taken during removal of concrete to prevent debris from falling into or entering adjacent tanks in service or from damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with non-shrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 2-inches from the finished face of the new opening and be painted with epoxy paint. The inside face of the new opening shall be grouted with an epoxy cement grout to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.

C. Where new piping is installed in existing structures, the CONTRACTOR shall accurately position core-drilled openings in the concrete as indicated or otherwise required. Openings shall be of sufficient size to permit a final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through the wall to provide watertightness around openings so formed. The boxes or cores shall be provided with continuous keyways to hold the filling material in place, and they shall have a slight flare to facilitate grouting and the escape of entrained air during grouting. Before placing the non-shrink grout, concrete surfaces shall be sandblasted, thoroughly cleaned of sand and any other foreign matter, and coated with epoxy bonding compound.

D. Pipes, castings, or conduits shall be grouted in place by pouring in grout under a head of at least 4-inches. The grout shall be poured or rammed or vibrated into place to fill completely the space between the pipes, castings, or conduits, and the sides of the openings so as to obtain the same watertightness as through the wall itself. The grouted casings shall then be water cured.

E. In locations where the surface of the grout will be exposed to view, the non-shrink grout shall be recessed approximately 1/2-inch and the recessed area filled with cement mortar grout.

F. When new piping is to be connected to existing piping, the existing piping shall be cut square and ends properly prepared for the connection. Any damage to the lining and coating of the existing piping shall be repaired. Dielectric insulating joints shall be installed at interconnections between new and existing piping.

G. Where existing equipment, piping, and supports, electrical panels and devices, conduits, and associated appurtenances are removed, the CONTRACTOR shall rehabilitate the affected area such that little or no evidence of the previous installation remains. Openings in concrete floors, walls, and ceilings from piping, conduit, and fastener penetrations shall be filled with non-shrink grout and finished to match the adjacent area. Concrete pads, bases associated with equipment, supports, and appurtenances shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 2-inches below finished grade and be painted with epoxy paint. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1-1/2 inches, and concrete within the scored lines removed to a depth of 1-1/2 inches (or the depth of cover over reinforcing steel, whichever is less). The area within the scored lines shall be patched with non-shrink grout to match the adjacent grade and finish. Abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit.

H. Existing reinforcement to remain in place shall be protected, cleaned, and extended into new concrete. Existing reinforcement not to be retained shall be cut-off as follows:

1. Where new concrete joins existing concrete at the removal line, reinforcement shall be cut-off flush with the concrete surface at the removal line.

2. Where the concrete surface at the removal line is the finished surface, the reinforcement shall be cut back 2-inches below the finished concrete surface, the ends painted with epoxy paint and the remaining holes patched with a cement mortar grout.

I. Where existing handrailing is removed, post embedments and anchors shall be removed and post holes shall be filled with non-shrink grout flush to the floor surface. At the point of continuation of existing handrailing, a new post with rail connections matching the existing handrailing system shall be installed. New posts in existing concrete floors shall be installed in core-drilled socket holes and the annular space between the post and hole filled with non-shrink grout.

J. Where reconstruction activities damage the painting and coating of adjacent or nearby facilities, the damaged areas shall be surface prepared and coated in accordance with Section 09 96 00 - Protective Coating to match the original painting and coating with a compatible system. Surfaces of equipment items that are to be relocated shall be prepared and be coated in accordance with Section 09 96 00 – Protective Coating.

3.5 DISPOSAL

A. Demolition and removal of debris shall minimize interference with roads, streets, walks, and other adjacent occupied or used facilities that shall not be closed or obstructed without permission from the OWNER. Alternate routes shall be provided around closed or obstructed traffic ways.

B. Site debris, rubbish, and other materials resulting from reconstruction operations shall be legally removed and disposed of. Structures and equipment to be demolished shall be cleaned prior to demolition and the wash water properly disposed of. No trace of these structures shall remain prior to placing of backfill in the areas from which structures were removed.

C. Refuse, debris, and waste materials resulting from demolition and clearing operations shall not be burned.

3.6 CLEANING

A. During and upon completion of WORK, the CONTRACTOR shall promptly remove tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by WORK in a clean, approved condition.

B. Adjacent structures and work areas shall be cleaned of dust, dirt, and debris caused by reconstruction, as requested by the ENGINEER or directed by governing authorities, and adjacent areas shall be returned to condition existing prior to start of WORK.

END OF SECTION

SECTION 03 01 30 - CONCRETE REPAIR AND REHABILITATION

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Remove, repair, or rehabilitate new concrete members and surfaces as indicated.

B. Provide all materials and equipment necessary to accomplish the WORK.

C. Repair damage to concrete and concrete surfaces which results from the removal of embedded items, from construction activities, or which existed previously in structures indicated to be repaired.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ACI 201.1R-08	Guide for Making a Condition Survey of Concrete in Service
ACI 546R-14	Concrete Repair Guide

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Submit Shop Drawings for strengthening required around new openings.

2. Submit detailed drawings showing proposed methods for supporting existing structures, equipment, and piping during demolition and repair activities.

C. Concrete Repair Products and Procedures

1. Submit a comprehensive plan for each repair method indicated within this Section, the plan shall including the following:

a. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each product.

b. Curing products and procedures for each repair method for which curing is recommended by the manufacturer.

1.4 QUALIFICATIONS OF CONCRETE RESTORATION FIRMS

A. The concrete restoration WORK shall be performed by an experienced firm customarily engaged in performing similar repair work on cast-in-place concrete structures.

B. The restoration firm shall have completed at least 5 similar projects in the last 5 years.

C. The restoration firm shall be certified by the manufacturer of the repair materials.

1.5 QUALITY ASSURANCE

A. Field Tests of Cement Based Mortars and Grouts

1. The ENGINEER may take compression test specimens during construction from the first placement of each type of mortar or grout, and at intervals thereafter as selected by the ENGINEER in order to ensure continued compliance with the indicated requirements.

2. The CONTRACTOR shall assist the ENGINEER in obtaining specimens for testing.

3. The compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed as specified in ASTM C 109.

4. A set of 5 specimens will be made for testing at 7 days, 28 days, and additional time periods as appropriate.

5. Any material, already placed, which fails to meet the indicated performance requirements is subject to removal and replacement as part of the WORK.

6. The cost of laboratory tests on mortar and grout will be paid by the OWNER, but the CONTRACTOR shall be responsible for the cost of any additional tests and investigation on the WORK that does not meet the indicated requirements.

7. The CONTRACTOR shall supply all necessary materials for fabricating the test specimens.

B. Repair Concrete: Repair concrete shall be tested as required in Section 03 31 50 – Cast-in-Place Concrete.

C. Epoxy Grout: Epoxy grout shall be tested as required in Section 03 60 00 – Grouting.

D. Construction Tolerances: Construction tolerances shall comply with the requirements of Section 03 31 50 – Cast-in-Place Concrete, except as otherwise indicated.

PART 2 -- PRODUCTS

2.1 GENERAL

A. All products and materials in contact with potable water shall be certified as being in conformance with ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects.

2.2 REPAIR MORTAR

A. Provide repair mortar as a pre-packaged, 2-component, polymer-modified, cementious, non-sag mortar, specifically formulated for the repair of surface defects.

B. Provide the mortar with a penetrating corrosion inhibitor.

C. Repair mortar shall have the following properties:

Physical Property	Value	ASTM Standard
Compressive Strength (min.) at 7 days 7000 psig at 28 days 2200 psig	 6000 psig 7000 psig	C-109
Bond Strength (min.) 98% C-666 at 28 days	 2200 psig	C-882 (modified)
Freeze/Thaw resistance (min.) 300 cycles	 98 percent	C-666

D. Provide a minimum repair thickness of 1/4 inch, unless otherwise indicated.

E. Repair Mortar shall be **SikaTop 123 Plus**, by **Sika Corporation**, or equal.

2.3 NON-SHRINK GROUT

A. Provide non-shrink grout conforming to the requirements of Section 03 60 00 – Grouting.

2.4 CONCRETE MATERIALS

A. Cement

1. Use Type II Portland cement unless otherwise indicated.

2. Where repairs are to be made on wall surfaces open to view and above normal water surface elevations, blend white Portland cement with the Type II cement as needed in order to match the color of the adjacent existing concrete surface.

B. Structural Repair Grout

1. Where required, provide structural repair grout meeting the requirements of Section 03 60 00 – Grouting.

2. Provide a minimum repair thickness of 3 inches.

C. Cement Grout

1. Provide cement grout that meets the requirements of Section 03 60 00 – Grouting.

2. Provide a minimum repair thickness of one inch.

D. Miscellaneous Materials**:** For concrete construction materials not covered specifically in this Section, conform to the requirements of Section 03 31 50 – Cast-in-Place Concrete.

2.5 AGGREGATE

A. Obtain the written permission of the manufacturer and ENGINEER before using aggregate to extend repair mortar and grout products.

B. If allowed and unless otherwise indicated, provide aggregate consisting of 3/8-inch clean, washed gravel or crushed stone as required in Section 03 31 50 – Cast-in-Place Concrete.

2.6 BONDING AGENT AND ANTI-CORROSION COATING

A. Provide a bonding agent that is a solvent-free, moisture-tolerant, epoxy-modified, cementitious product, specifically formulated as a bonding agent and anti-corrosion coating.

B. Bonding Agent shall be **Armatec 110 EpoCem**, by **Sika Corporation**, or equal.

2.7 EPOXY GROUT

A. Provide an epoxy grout conforming to the requirements of Section 03 60 00 – Grouting.

2.8 EPOXY RESIN

A. Use epoxy resin for structural crack repair.

B. For crack injection, provide a 2-component, moisture-tolerant, low-viscosity, high-strength epoxy resin adhesive that is specially formulated for that usage.

C. Provide a minimum bond strength of 2900 psi when tested per ASTM C 882 at 14 days, moist cured.

D. Epoxy Resin shall be **Sikadur 35, Hi-Mod LV**, by **Sika Corporation**, **KEMKO 068 LoVis IR**, by **ChemCo Systems, Inc.**, or equal.

2.9 PROTECTIVE COATING

A. Waterproofing

1. Provide a 2-component, polymer-modified, cementitious waterproofing and protective slurry mortar for concrete.

2. Apply the material in 2 coats, with a coverage of 40 sq ft/gal/coat.

3. Waterproofing shall be **Sika Top Seal 107**, by **Sika Corporation**, or equal.

2.10 FORMWORK

A. Where needed, provide formwork that meets the requirements of Section 03 31 50 – Cast In Place Concrete.

2.11 REINFORCEMENT STEEL

A. Where required, provide reinforcing steel that meets the requirements of Section 03 31 50 – Cast-in-Place Concrete.

2.12 POLYURETHANE SEALANT

A. Provide a 2-part polyurethane, gun-grade sealant.

B. Polyurethane Sealant shall be **Sikaflex – 2C**, by **Sika Corporation**, or equal.

2.13 POLYURETHANE CHEMICAL GROUT

A. Use polyurethane chemical grout for non-structural crack repair.

B. Polyurethane Chemical Grout shall be **SikaFix HH**, by **Sika Corporation**, **Flex LV PURe**, by **WR Grace/De Neef**, **Flex SLV PURe**, by **WR Grace/De Neef**, or equal.

2.14 HYDROPHILIC WATERSTOP

A. Provide hydrophilic waterstop of the type which expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.

B. Provide hydrophilic waterstop that is bentonite-free, and manufactured from chloroprene rubber and modified chloroprene rubber with hydrophilic properties.

C. Hydrophilic Waterstop shall be **Hydrotite RSS-040 P**, by **Greenstreak Group, Inc.**, KM **4mm String**, by **Adeka Ultra Seal**, or equal.

2.15 HIGH STRENGTH EPOXY GEL

A. High-Strength Epoxy Gel for crack surface sealing shall be **Denepox Rapidgel**, by **WR Grace/De Neef**, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Repairs

1. Repair techniques will be reviewed during the pre-construction meeting between the CONTRACTOR, ENGINEER, and OWNER.

2. The CONTRACTOR shall be familiar with the cause of deteriorated concrete and shall choose the right equipment, repair materials and techniques to be used for each particular repair.

3. Choose repair materials to match the adjacent concrete surface in color and texture.

4. Apply repair materials in strict accordance with the manufacturer's printed instructions, including temperature and moisture requirements throughout application and curing.

5. Protect adjacent portions of the structure, including all valves, pipes, mechanical equipment, and filter media from debris generated by repair activities.

6. For portions of the structure that are not identified to be repaired, maintain in their original condition.

B. Structural Stability

1. Use caution not to weaken the structural capacity of a beam, column, wall, slab, walkway, or other concrete member during concrete removal.

2. For severely deteriorated concrete members, consult with the ENGINEER before removing a major portion of any structural member.

3. Shoring may be required in order to support the structure and to protect workers.

C. Provide off-site disposal of debris generated as a result of repair procedures.

D. Provide concrete construction procedures not specifically addressed in this Section in accordance with the requirements of Section 03 31 50 – Cast-in-Place Concrete.

3.2 CRACK REPAIR

A. Structural Cracks - Structural Cracks are defined as follows:

1. All cracks where reinforcing steel is passing across the crack, including erratic cracks, and cracks at construction joints.

2. Cracks identified by the ENGINEER as structural cracks.

3. Repair structural cracks with epoxy resin.

B. Non Structural Cracks - Non Structural Cracks are defined as follows:

1. Cracks occurring at flexible joints, contraction joints or expansion joints.

2. Cracks identified by the ENGINEER as non structural cracks.

3. Repair non-structural cracks with polyurethane chemical grout.

C. Efflorescence

1. Prior to the crack repair, clean efflorescence from the cracks and the surrounding area.

2. Clean the efflorescence by light hydro-blasting or scrubbing.

D. Pressure Injection: Pressure Injection to be performed prior to leak testing and roof membrane installation.

1. General

a. The indicated repair materials have been selected to minimize the loss of material during the injection process. The areas selected for crack repair are to be identified by the Contractor, Engineer or Construction Manager and be determined prior to leak tests and roof membrane installation. The injection of cracks may also be required as a result of the leak test.

b. In order to avoid excessive loss of injected material at the lower exposed portions of the cracks, space the injection ports a distance no greater than the thickness of the wall being repaired.

2. Open through thickness structural cracks are to be repaired to deliver a water tight hydraulic structure passing the specified leakage test. All 3 foot long minimum or greater through thickness cracks greater than a minimum 15 mil thickness in the walls are to be injected unless they do not accept grout. All 2 foot long minimum through thickness cracks greater than 10 mil thickness in the foundation, water conduits, floor slabs and roof are to be injected unless they do not accept grout. Perform structural crack repairs by pressure injection in accordance with the manufacturer's directions, and in accordance with the following basic procedure:

   a. Remove unsound and foreign materials from the crack in a manner that does not trap debris in the crack and prevent the flow of repair materials.

   b. Remove any contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. For potable water applications, any solvents must be fully flushed from the joint unless NSF/ANSI Standard 61 approved.

   c. Install the injection ports in accordance with the manufacturer's directions.

   d. Sealing

      1) Seal the surface in order to keep the pressure injecting materials from leaking out before it has set or gelled.

      2) Seal a surface by brushing an epoxy over the surface of the crack and allowing it to harden, or use high injection pressures to cut-out the cracks in a 'V' shape, fill with an epoxy, and strike off flush with the surface.

      3) Surface patching or sealant shall be performed where needed to provide for complete penetration of the injected polyurethane grout and to prevent wastage. Seal surface of crack with fast setting hydraulic cement or high strength epoxy gel. The floor surface along the cracks shall be cleaned and all wasted grout and surface seal material shall be completely removed from the concrete surface following completion of the repair work

   e. Inject the repair materials, with consideration of the following items:

      1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.

      2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, then cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled.

      3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.

      4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end, using low-viscosity repair material.

f. Cleanup

1) Remove the surface seal by grinding or other appropriate means.

2) Coat fittings and holes at injection ports with an epoxy patching compound.

3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.

3. Open through thickness non-structural cracks are to be repaired to deliver a water tight hydraulic structure passing the specified leakage test. Open through thickness cracks with lengths of at least 3 feet on each side of the wall and roof, at least 2 feet of length on the foundation or floor slab are to be injected unless they do not accept grout. All 3 foot long minimum or greater through thickness cracks greater than a minimum 15 mil thickness in the walls are to be injected unless they do not accept grout. All 2 foot long through thickness cracks greater than 10 mil thickness in the floors and roof are to be injected unless they do not accept grout. Perform non-structural crack repairs in accordance with the manufacturer's directions, and in accordance with the following basic procedure:

a. Remove unsound and foreign materials from the crack in a manner that does not trap debris in the crack and prevent the flow of repair materials.

b. Remove contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. Any solvents must be fully flushed from the joint unless NSF/ANSI Standard 61 approved.

c. Install the injection ports in accordance with the manufacturer's directions.

d. Moisture

1) For non-structural cracks, moisture must be present for the chemical grout to react.

2) Prior to injecting the repair materials, inject the crack with a small amount of water in order to completely moisten the crack.

e. Inject the repair materials, with consideration of the following items:

1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.

2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled, and then, starting again at the lowest port, re-inject into all ports in order to ensure that all voids are properly sealed off.

3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.

4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end.

f. Cleanup

1) Remove excess surface material by grinding or other appropriate means.

2) Coat fittings and holes at injection ports with an epoxy patching compound.

3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.

3.3 SPALLED AND DELAMINATED CONCRETE REPAIR

A. Repair spalls and delaminated concrete using repair mortar.

B. Surface Preparation

1. Remove all delaminated concrete and all unsound concrete beyond the spalled or delaminated area.

2. Boundaries

a. Determine the boundaries of the patch by sawcuts to a depth of at least 1/4 inch up to one inch deep.

b. Refer to the Structural Drawings for sawcut locations.

c. Where the sawcut locations are not shown on the Drawings, the boundaries shall be layouts designed to reduce boundary edge length.

d. Avoid excessive or complex edge conditions.

3. Sawcuts

a. Perform sawcuts perpendicular to the surface or slightly undercut.

b. Construct sawcuts in maximum 1/4-inch increments.

c. After each incremental cut, inspect the cut surface in order to ensure that the existing reinforcement has not been cut.

d. If at any depth the reinforcement becomes exposed, terminate the sawcut and notify the ENGINEER.

4. Chip away concrete within the repair area to a depth sufficient to expose sound concrete over the entire repair area, or to a minimum depth required by repair mortar, whichever is greater.

5. Base the selection of partial depth concrete removal equipment on the size of repair area, depth of concrete to be removed, and the location of the deteriorated concrete such as wall, slab-on-grade, underside or top of elevated slab.

6. Removal

    a. The maximum allowable pneumatic chipping hammer shall be a 30-lb class hammer.

    b. Hydroblast removal shall use a maximum pressure of 40,000 psig.

    c. Sand blasting is not permitted.

    d. Hydroblast concrete removal is recommended for large area of surface defects.

    e. Remove water blasting debris daily in order to prevent it from setting up.

    f. If a chipping hammer is used, ensure that the existing reinforcement is not damaged during the concrete removal operations.

    g. Remove protrusions, such as mortar spatter or fins, by grinding or by striking with a hammer or other tool.

7. Reinforcement

    a. Remove concrete from around reinforcement when the rebar is rusted, more than half the rebar perimeter is already exposed, the concrete bond around the rebar is broken, or if the concrete is unsound or honey-combed.

    b. Remove concrete in order to provide a clear space of minimum one inch on all sides of the reinforcement, such that the rebar can be cleaned and the repair material will completely surround the rebar.

    c. Clean exposed reinforcement by water blasting or wire brushing.

    d. After fully exposing and cleaning the reinforcement, check for steel deterioration, and if the cross-sectional area of the steel has been reduced by more than 10 percent, whether by deterioration, surface preparation, or a combination of both, provide additional reinforcement.

    e. Consult with the ENGINEER before adding or replacing rebar.

C. Repairing Surface Defects

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning the reinforcement.

2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.

3. Remove dust, including new dust generated by surface preparation or scarifying.

4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer’s recommendations, allow the coating to dry, reapply the coating, and allow to dry again.

5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer’s recommendations.

6. Repair Mortar

    a. Apply repair mortar in accordance with the manufacturer's recommendations.

    b. The thickness of each lift of repair mortar shall be in accordance with the manufacturer's recommendations, with the minimum thickness being not less than 1/4 inch.

7. Fully consolidate the repair mortar, working the material into the substrate to completely fill all pores and voids in the area to be filled.

8. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.

9. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.

10. Float-finish the repaired surface using wood or sponge floats.

11. For repaired surfaces to receive a protective coating, brush-finish the surface in order to produce a roughened substrate for the coating.

12. Minimum and maximum ambient and surface temperatures shall be as recommended by repair material manufacturer.

D. Curing

1. Curing of repair mortar to receive waterproofing shall be as follows:

    a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;

    b. Weight the curing blankets or otherwise held them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;

    c. Ensure that edges are continuously held in place; and,

    d. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.

2. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.

3. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.4 SCALED CONCRETE REPAIR

A. Repair scaling and pop-outs using repair mortar.

B. Surface Preparation

1. Prior to repair, prepare the surface in accordance with the repair mortar manufacturer's recommendations with the following minimum requirement.

2. Remove unsound concrete from surfaces by high-pressure water blasting, using a minimum pressure of 10,000 psigg and maximum pressure of 40,000 psigg.

3. Clean exposed reinforcement by water blasting or wire brushing.

C. Repairing Surface Defects

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning reinforcement.

2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.

3. Remove dust, including new dust generated by surface preparation or scarifying.

4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.

5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.

6. Apply repair mortar in accordance with the manufacturer's recommendations, using a minimum repair material thickness of 1/4 inch.

7. Fully consolidate the repair material, working the material into the substrate to completely fill all pores and voids in the area to be filled.

8. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.

9. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.

10. Float-finish the repaired surface using wood or sponge floats.

D. Provide strip joint in newly placed mortar at the location of repaired cracks.

E. Curing

1. Curing of repair mortar to receive waterproofing shall be as follows:

a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;

b. Weight the curing blankets or otherwise held them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;

c. Ensure that edges are continuously held in place; and,

d. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.

2. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.

3. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.5 POP-OUT REPAIR, AND REPAIR OF OTHER SURFACE DAMAGE, DETERIORATION, OR DEFECTS

A. Repair pop-outs and other surface damage, deterioration, and defects which are 1/4 inch deep or shallower, using the procedures described under "SCALED CONCRETE REPAIR," above.

B. Repair other pop-outs and surface damage, deterioration, and defects using the procedures described under "SPALLED AND DELAMINATED CONCRETE REPAIR," above.

3.6 REPLACEMENT OF CONCRETE SECTIONS WHICH REQUIRE COMPLETE REPLACEMENT

A. Refer to the Structural Drawings for locations where the level of concrete deterioration is such that complete removal and replacement of the deteriorated section is required.

B. At these locations, remove the deteriorated concrete in accordance with the details on the Structural Drawings and the requirements of this Section.

C. Limits

1. The limits of concrete removal shall be as indicated on the Structural Drawings.

2. If no limits of removal are indicated, determine the limits in accordance with the procedures described under "Boundaries – Spalled and Delaminated Concrete Repair."

D. Provide sawcuts in accordance with the procedures described under "Sawcuts – Spalled and Deliminated Concrete Repair."

E. After removal of the concrete, prepare the area and provide repair concrete in accordance with the details on the Structural Drawings and the requirements of this Section.

F. Unless otherwise indicated, match the finished cross-section of the repaired concrete to the cross-section of the adjacent undamaged concrete.

3.7 PATCHING OF HOLES IN CONCRETE

A. General

1. For the purposes of this Section, holes are defined as penetrations completely through the concrete member and with interior surfaces approximately perpendicular to the surface of the existing member.

2. Interior surface areas which are inclined and do not meet this criteria shall be chipped as needed to meet this requirement.

3. The perimeter of holes at the surface shall form a regular shape composed of curved or straight line segments.

4. Provide the minimum depth of placement for the material used; score the existing concrete by sawcutting, and chip as needed to meet this requirement.

5. Roughen the interior surface of holes less than 12 inches in diameter to a minimum of 0.125-inch amplitude, and roughen larger holes to a minimum of 0.25-inch amplitude.

6. At holes, coat the existing surface to be repaired with a bonding agent.

B. Patching Small Holes: For holes which are less than 12 inches in their least dimension and extend completely through concrete members, fill with non-shrink grout.

C. Patching Large Holes

1. Fill holes which are larger than 12 inches in their least dimension with structural repair grout.

2. Provide large holes which are normally in contact with water or soil with hydrophilic waterstop placed in a groove.

3. Alternatively, bond the hydrophilic waterstop to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material.

4. Install the waterstop in accordance with the requirements of Section 03 31 50 – Cast-in-Place Concrete.

5. Provide reinforcing steel in layers matching existing reinforcement location, size, spacing and cover requirements unless directed otherwise by the ENGINEER.

6. In locations where NSF/ANSI Standard 61 approval is required by the authority having jurisdiction, use one of the following procedures:

   a. Provide Product Data showing the proposed structural repair grout is NSF/ANSI Standard 61 approved.

   b. Complete the repair with structural repair grout. Coat all surfaces required to have NSF/ANSI Standard 61 approval completely with Sikadur 31, Tyfo S, or equal.

   c. Place the structural repair grout to within 1 ½” of the finished surface of the repair. Complete the remainder of the repair with SikaTop123 Plus, or equal.

3.8 PATCHING OF LINED HOLES

A. General

1. This WORK applies to those openings which have embedded material over all or a portion of their inside edge.

2. The requirements for repairing holes in concrete, as indicated above, apply as modified herein.

3. The ENGINEER will determine whether the embedded material is allowed to remain.

B. Where embedded material is allowed to remain, trim it back a minimum of 2 inches from the concrete surface.

C. Roughen or abrade the embedded material in order to promote good bonding to the repair material.

D. Remove substances that interfere with good bonding.

E. Completely remove embedded items that are not securely and permanently anchored into the concrete.

F. Completely remove embedded items which are larger than 12 inches in their least dimension, unless they are composed of a metal to which reinforcing steel can be welded; where reinforcement is required, weld it to the embedded metal.

G. The following requirements shall apply to concrete members which are in contact with water or soil:

1. Using epoxy grout, fill lined openings which are less than 4 inches in their least dimension;

2. Using an epoxy bonding agent, coat lined openings which are greater than 4 inches but less than 12 inches in their least dimension, prior to being filled with non-shrink grout.

3. Using an epoxy bonding agent, coat lined openings which are greater than 12 inches in their least dimension, and provide a hydrophilic waterstop bonded to the interior of the opening with epoxy adhesive, prior to being filled with approved repair material.

3.9 APPLICATION OF PROTECTIVE COATINGS

A. Waterproofing

1. Apply waterproofing in accordance with the manufacturer’s printed instructions.

2. Do not begin waterproofing WORK until repairs and new construction in the affected area have been completed and adequately cured.

3.10 EXPANSION JOINT REPAIR

A. Repair deteriorated expansion joints as follows:

1. Completely remove existing sealant;

2. Remove defective backer materials in the joint;

3. Sand-blast the joint and prepare the surface in accordance with the sealant manufacturer's instructions;

4. Prepare the wall surface on each side of the joint in accordance with the expansion joint manufacturer's instructions;

5. Ensure that the prepared surface is clean, sound, and bare concrete;

6. Place backer material in the joint;

7. Apply a primer recommended by the sealant manufacturer;

8. Fill the joint with polyurethane sealant;

9. Allow a minimum of 3 days curing prior to installing the expansion joint; and,

10. Install the expansion joint in accordance with the manufacturer's instructions.

END OF SECTION

SECTION 03 31 50 - CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide cast-in-place concrete, joints in concrete, reinforcement steel and appurtenant work, formwork, bracing, shoring, supports, and shall design and construct falsework, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Shop Drawings

1. Shop bending diagrams, placing lists, and drawings of reinforcing steel prior to fabrication.

2. Details of the concrete reinforcing steel and concrete inserts shall be submitted at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Details of reinforcing steel for fabrication and erection shall conform to ACI 315V and the requirements herein. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. Include bar placement diagrams which clearly indicate the dimensions of each bar splice.

3. Where mechanical couplers are required or permitted to be used to splice reinforcing steel, submit manufacturer's literature which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and Shop Drawings that show the location of each coupler with details of how they are to be installed in the formwork.

4. Manufacturer's information demonstrating compliance with requirements of the following:

a. Bearing pads

b. Neoprene sponge

c. Preformed joint filler

d. Backing rod

e. Bond breaker

f. Slip dowels

g. PVC tubing

h. Form ties and related accessories

i. Form gaskets

j. Form release agent

k. List of form materials and locations of use

l. Mill tests for cement

m. Admixture certification. Chloride ion content shall be included.

n. Aggregate gradation test results and certification

o. Materials and methods for curing

5. Placement drawings showing the location and type of joints for each structure.

C. Mix Designs**:** Prior to beginning the WORK, submit preliminary concrete mix designs which shall show the proportions and gradations of materials proposed for each class and type of concrete. The mix designs shall be checked by an independent testing laboratory acceptable to the ENGINEER. Costs related to such checking shall be the CONTRACTOR's responsibility. When a water reducing admixture is to be used, the CONTRACTOR shall furnish mix designs for concrete both with and without the admixture.

D. Delivery Tickets: Where ready-mix concrete is used, the CONTRACTOR shall furnish certified delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state certified equipment used for measuring, and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, the amounts of water in the aggregate, added at the batching plant, and the amount allowed to be added at the Site for the specific design mix. In addition, each certificate shall state the mix number, total yield in cubic yards, and the time of day to the nearest minute, corresponding to the time when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

1.3 QUALITY ASSURANCE

A. Testing of Reinforcing Steel

1. If requested by the ENGINEER, the CONTRACTOR shall furnish samples from each heat of reinforcing steel in a quantity adequate for testing. Costs of initial tests will be paid by the OWNER. Costs of additional tests, if material fails initial tests, shall be the CONTRACTOR's responsibility.

B. Testing of Materials

1. Tests on component materials and for compressive strength of concrete will be performed as indicated herein. Tests for determining slump will be in accordance with the requirements of ASTM C 143 - Standard Test Method for Slump of Hydraulic Cement Concrete.

2. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness in accordance with ASTM C 33 - Concrete Aggregates.

3. The cost of laboratory tests on cement, aggregates, and concrete, will be paid by the OWNER. However, the CONTRACTOR shall pay the cost of any additional tests and investigations on WORK that does not meet the Specifications. The laboratory will meet or exceed the requirements of ASTM C 1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.

4. Concrete for testing shall be furnished by the CONTRACTOR at no cost to the OWNER, and the CONTRACTOR shall assist the ENGINEER in obtaining samples and disposal and cleanup of excess material.

C. Field Compression Tests

1. Compression test specimens shall be taken during construction from the first placement of each class of concrete herein and at intervals thereafter as selected by the ENGINEER to insure continued compliance with these Specifications. Each set of test specimens will be a minimum of 4 cylinders.

2. Compression test specimens for concrete will be made in accordance with Section 9.2 of ASTM C 31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field. Specimens will be 6-inches diameter by 12-inches high cylinders.

3. Compression tests will be performed in accordance with ASTM C 39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. One test cylinder will be tested at 7 Days and 2 at 28 Days. The remaining cylinder will be held to verify test results, if needed.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete will be according to the requirements of ACI 318 - Building Code Requirements for Reinforced Concrete, Chapter 26 "Construction Documents and Inspection", and as indicated herein.

2. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for subsequent batches of the type of concrete affected.

3. Concrete that fails to meet the ACI requirements and these Specifications is subject to removal and replacement as part of the WORK.

E. Construction Tolerances: The CONTRACTOR shall set and maintain concrete forms and perform finishing operations so that the concrete is within the tolerances herein. Surface defects and irregularities are defined as finishes and are to be distinguished from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated. Where tolerances are not indicated, permissible deviations will be in accordance with ACI 117 - Standard Tolerance for Concrete Construction and Materials.

1. The variation from required lines or grades shall not exceed 1/4-inch in 10-feet and there shall be no offsets or visible waviness in the finished surface.

PART 2 -- PRODUCTS

2.1 FORM AND FALSEWORK MATERIALS

A. Except as otherwise expressly accepted by the ENGINEER, lumber for use as forms, shoring, or bracing shall be new material.

B. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:

1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20 - American Softwood Lumber Standard.

2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 - Construction and Industrial Plywood for Concrete Forms, Class I, and shall be edge sealed.

3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade required. Metal forms shall be an approved type that will accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.

C. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers or be tooled to a 1/2-inch radius. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.

D. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 psf (minimum). The minimum design load for combined dead and live loads shall be 100 psf.

2.2 FORM TIES

A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties or other removable form-tie fasteners having a circular cross-section shall not exceed 1-1/2 inches; and such fasteners shall be such as to leave holes of regular shape for reaming. Form ties shall be ST-4 Standard and Heavy SnapTiesby **MeadowBurke, Snap Ties** by **Dayton Superior**, or equal.

B. Removable taper ties may be used when approved by the ENGINEER. Taper ties shall be **Taper Ties** by **MeadowBurke, Taper Ties** by **Dayton Superior**, or equal.

2.3 REINFORCEMENT STEEL

A. General: Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar reinforcement shall conform to the requirements of ASTM A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, for Grade 60 Billet Steel Reinforcement, unless otherwise indicated.

B. Accessories

1. Accessories shall include necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. Bar supports shall meet the requirements of the CRSI Manual of Standard Practice including special requirements for supporting epoxy coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.

2. Concrete blocks (dobies) used to support and position reinforcement steel shall have the same or higher compressive strength than required for the concrete in which they are located. Where concrete blocks are used on concrete surfaces exposed to view, the color and texture of the concrete blocks shall match that required for the finished surface. Wire ties shall be embedded in concrete block bar supports.

C. Epoxy coating for reinforcing and accessories, where indicated, shall conform to ASTM A 775 - Epoxy Coated Reinforcing Steel Bars.

2.4 MECHANICAL COUPLERS

A. Mechanical couplers shall be provided where indicated and where approved by the ENGINEER. Couplers shall develop a tensile strength that exceeds 125 percent of the yield strength of the reinforcing bars being spliced at each splice.

2.5 WELDED SPLICES

A. Welded splices shall be provided where indicated and where approved by the ENGINEER. Welded splices of reinforcement steel shall develop a tensile strength exceeding 125 percent of the yield strength of the reinforcing bars that are connected.

B. Materials required to perform the welded splices to the requirements of AWS D1.4 shall be provided.

2.6 CONCRETE MATERIALS

A. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Only one brand of cement shall be used. Cement reclaimed from cleaning bags or leaking containers shall not be used. Cement shall be used in the sequence of receipt of shipments.

B. Materials for the WORK shall comply with the requirements of Sections 201, 203, and 204 of ACI 301- Structural Concrete for Buildings, as applicable.

C. Storage of materials shall conform to the requirements of Section 205 of ACI 301.

D. Materials for concrete shall conform to the following requirements:

1. Cement shall be standard brand portland cement conforming to ASTM C 150 - Portland Cement for Type II or Type V.

2. Water shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (over 1000 mg/l TDS) shall not be used.

3. Aggregates shall be obtained from pits acceptable to the ENGINEER, shall be non-reactive, and shall conform to ASTM C 33. Maximum size of coarse aggregate shall be as indicated. Lightweight sand for fine aggregate will not be permitted.

4. Ready-mix concrete shall conform to the requirements of ASTM C 94 - Ready-Mixed Concrete.

5. Air-entraining agent meeting the requirements of ASTM C 260 – Air Entraining Admixtures for Concrete shall be used. Concrete floors to receive a dry-shake floor hardener shall have an air content not to exceed 3 percent. The OWNER reserves the right, at any time, to sample and test the air-entraining agent. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. Air content shall be tested at the point of placement. Air entraining agent shall be **Micro-Air** by **Master Builders, Daravair** by **W.R. Grace, Sika AEA-15** by **Sika Corporation,** or equal.

6. Admixtures: Admixtures may be added at the CONTRACTOR's option to control the set, affect water reduction, and increase workability. In either case, the addition of an admixture shall be at the CONTRACTOR's expense. The use of an admixture shall be subject to acceptance by the ENGINEER. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture. Admixtures shall conform to the requirements of ASTM C 494 - Chemical Admixtures for Concrete. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used. Admixtures shall contain no free chloride ions, shall be non-toxic after 30 Days, and shall be compatible with and made by the same manufacturer as the air entraining admixture.

   a. Concrete shall not contain more than one water-reducing admixture. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER.

   b. Set controlling admixture may be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as **Plastocrete 161 MR** by **Sika Corporation, Pozzolith R300** by **Master Builders, Daratard** by **GCP Applied Technologies,** or equal shall be used. Where the air temperature at the time of placement is expected to be consistently under 40 degrees, a set accelerating admixture such as **Plastocrete 161FL** by **Sika Corporation, MasterSet FP 20** by**Master Builders, Polarset** by **GCP Applied Technologies,** or equal shall be used.

   c. Normal range water reducer shall conform to ASTM C 494, Type A. It shall be **WRDA 79** by**GCP Applied Technologies, Pozzolith 322-N** by**Master Builders, Plastocrete 161** by **Sika Corporation,** or equal. The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.

7. Calcium Chloride: Calcium chloride will not be permitted in concrete.

2.7 CURING MATERIALS

A. Materials for curing concrete shall conform to the following requirements and ASTM C 309 - Liquid Membrane-Forming Compounds for Curing Concrete:

1. Curing compounds shall be white-pigmented and resin-based. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be **Kurez VOX White Pigmented** by **Euclid Chemical Company, Cure R-2** by **L&M Construction Chemicals, 1200-White** by **W.R. Meadows,** or equal. When curing compound must be removed for finishes or grouting, curing compounds shall be **Kurez DR VOX** by **Euclid Chemical Company, Masterkure HD100WB** byMaster Builders**, L&M Cure R** by **L&M Construction Chemicals, 1100-Clear** by **WR Meadows,** or equal. Curing compounds shall meet local VOC requirements.

2. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6-mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 - Standard Test Method for Water Retention by Concrete Curing Materials, shall not exceed 0.055 grams per square centimeter of surface.

3. Evaporation retardant shall be a material such as **MasterKure ER 50** by **Master Builders, Eucobar** by **Euclid Chemical Company, E-CON** by **L&M Construction Chemicals, Inc.,** or equal.

2.8 JOINT MATERIALS

A. Materials for joints in concrete shall conform to the following requirements:

1. Joint filler material shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. Non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction; for Type I, except as otherwise indicated.

2. Elastomeric joint sealer shall conform to the requirements of Section 07 92 13 - Sealants and Caulking.

3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement due to expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth hereinafter, if testing is required by the ENGINEER.

2.9 MISCELLANEOUS MATERIALS

A. Dampproofing agent shall be an asphalt emulsion such as MasterSeal 610by**Master Builders, Emulsified Asphalt** by **Euclid Chemical Company, Sealmastic** by **W. R. Meadows Inc.**, or equal.

B. Epoxy adhesives shall be the following products:

1. For bonding freshly-mixed, plastic concrete to hardened concrete, **Sikadur 32 Hi-Mod Epoxy Adhesive** by **Sika Corporation, MasterEmaco ADH 326** by **Master Builders**; **BurkEpoxy MV** by **Burke** by **Edoco,** or equal.

2. For bonding hardened concrete or masonry to steel, **Sikadur 31 Hi-Mod Gel** by **Sika Corporation, BurkEpoxy NS** by **Burke** by **Edoco, MasterEmaco ADH 327**by**Master Builders**; or equal.

C. Epoxy grout for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements in Section 03 60 00 - Grouting.

2.10 CONCRETE DESIGN REQUIREMENTS

A. General

1. Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage, and where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The proportions shall be changed whenever necessary or desirable to meet the required results at no additional cost to the OWNER. Mix changes shall be subject to review by the ENGINEER.

2. The CONTRACTOR is cautioned that the limiting parameters below are NOT a mix design. Admixtures may be required to achieve workability required by the CONTRACTOR's construction methods and aggregates. The CONTRACTOR is responsible for providing concrete with the required workability.

B. Water-Cement Ratio and Compressive Strength: The minimum compressive strength and cement content of concrete shall be not less than the following tabulation.

Type of Work	Class of Concrete Min 28-Day Compressive Strength, psi	Max Size Aggregate in	Cement Content Per cu yd, lbs	Max W/C Ratio (by weight)
Structural concrete	4,500	1	564 to 600	0.45

2.11 CONSISTENCY

A. Consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143. The slumps shall be as follows:

Part of Work	Slump (in
All concrete unless indicated otherwise	3-inches plus or minus 1-inch
Ductbank and pipe encasement	5-inches plus or minus 1-inch

2.12 MEASUREMENT OF CEMENT AND AGGREGATE

A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the ENGINEER; provided that, where batches are so proportioned as to contain an integral number of conventional sacks of cement and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 pounds.

2.13 MEASUREMENT OF WATER

A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the ENGINEER and capable of measuring the water in variable amounts within a tolerance of one percent.

2.14 READY-MIXED CONCRETE

A. At the CONTRACTOR'S option, ready-mixed concrete may be used if it meets the requirements as to materials, batching, mixing, transporting, placing, the supplementary requirements as required herein, and is in accordance with ASTM C 94.

B. Ready-mixed concrete shall be delivered to the WORK, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever comes first. In hot weather, under conditions contributing to quick stiffening of the concrete, or when the temperature of the concrete is 85 degrees F or above, the time between the introduction of the cement to the aggregates and discharge shall not exceed 45 minutes.

C. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be of the resettable, recording type, and shall be mounted in the driver's cab. The counter shall be actuated at the time of starting the mixer at mixing speed.

D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. Materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

E. Each batch of ready-mixed concrete delivered to the WORK shall be accompanied by a delivery ticket furnished to the ENGINEER in accordance with the requirements above.

F. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the ENGINEER.

PART 3 -- EXECUTION

3.1 GENERAL FORMWORK REQUIREMENTS

A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of forms, and any forms that are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced. A sufficient number of forms of each kind shall be available to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and federal regulations. Design, construction, maintenance, preparation, and removal of forms shall be in accordance with ACI 347 - Guide to Formwork for Concrete and the requirements herein.

B. Forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete.

3.2 CONSTRUCTION

A. Vertical Surfaces: Vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is indicated. Not less than 1-inch of concrete shall be added to the indicated thickness of a concrete member where concrete is permitted to be placed against trimmed ground in lieu of forms. Permission to do this on other concrete members will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

B. Construction Joints: Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the ENGINEER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory affect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. Form Ties

1. Embedded Ties: Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.

2. Removable Ties: Where taper ties are approved for use, after the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink or regular cement grout. Exposed faces of walls shall have at least the outer 2-inches of the exposed face filled with a cement grout which shall match the color and texture of the surrounding wall surface.

3.3 REUSE OF FORMS

A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view.

3.4 REMOVAL OF FORMS

A. Careful procedures for the removal of forms shall be strictly followed, and this WORK shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. Members which must support their own weight shall not have their forms removed until they have attained at least 75 percent of the 28-Day strength of the concrete. Forms for vertical walls and columns shall remain in place at least 48

hours after the concrete has been placed. Forms for parts of the WORK not specifically mentioned herein shall remain in place for periods of time as recommended in ACI 347.

3.5 GENERAL REINFORCEMENT REQUIREMENTS

A. Reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the supplementary requirements indicated herein.

3.6 FABRICATION

A. General

1. Reinforcement steel shall be accurately formed to the dimensions and shapes indicated, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as modified by the Drawings.

2. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings. Said drawings, diagrams, and lists shall be prepared by the CONTRACTOR.

3. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner that will injure the material. Bars shall be bent or straight as indicated. Do not use bends different from the bends indicated. Bars shall be bent cold unless otherwise permitted by the ENGINEER. No bars partially embedded in concrete shall be field-bent except as indicated or specifically permitted by the ENGINEER.

3.7 PLACING

A. Reinforcement steel shall be accurately positioned as indicated and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. Reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers that are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. Concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall provide concrete, metal, plastic, or other acceptable bar chairs and spacers.

B. The portions of accessories in contact with the formwork shall be made of concrete, plastic, or steel coated with a 1/8-inch minimum thickness of plastic which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.

C. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.

D. Bars additional to those indicated which may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR as part of the WORK.

E. Unless otherwise indicated, reinforcement placing tolerances shall be within the limits specified in Section 20.6 of ACI 318 except where in conflict with the requirements of the Building Code.

F. The minimum spacing requirements of ACI 318 shall be followed for reinforcing steel.

G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters having gray, plastic-coated standard type legs. Slab bolsters shall be spaced not more than 30-inches on centers, shall extend continuously across the entire width of the reinforcing mat, and shall support the reinforcing mat in the plane indicated.

H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3-feet on centers in any direction. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.

3.8 SPLICING

A. General: Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where indicated, the character of the splice shall be reviewed and accepted by the ENGINEER.

B. Splices of Reinforcement

1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318, Section 25.5.2for a Class B splice.

2. Welded splices shall be performed in accordance with AWS D1.4.

3. Laps of welded wire fabric shall be in accordance with the ACI 318. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet. Wires shall be staggered and tied in such a manner that they cannot slip.

3.9 CLEANING AND PROTECTION

A. Reinforcement steel shall always be protected from conditions conductive to corrosion until concrete is placed around it.

B. The surfaces of reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcing shall be reinspected and, if necessary recleaned.

3.10 PROPORTIONING AND MIXING

A. Proportioning: Proportioning of the concrete mix shall conform to the requirements of Chapter 3 "Proportioning" of ACI 301.

B. Mixing: Mixing of concrete shall conform to the requirements of Chapter 7 ACI 301.

C. Slump: Slumps shall be as indicated herein.

D. Retempering: Retempering of concrete or mortar which has partially hardened shall not be permitted.

3.11 PREPARATION OF SURFACES FOR CONCRETING

A. General: Earth surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

B. Joints in Concrete: Concrete surfaces upon or against which concrete is to be placed, where the placement of the concrete has been stopped or interrupted so that, as determined by the ENGINEER, the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of laitance, loose or defective concrete, and foreign material, and be roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting. Pools of water shall be removed from the surface of construction joints before the new concrete is placed.

C. Placing Interruptions: When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means, that will secure proper union with subsequent WORK; provided that construction joints shall be made only where acceptable to the ENGINEER.

D. Embedded Items

1. No concrete shall be placed until formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the ENGINEER at least 4 hours before placement of concrete. Surfaces of forms and embedded items that have become encrusted with dried grout from previous usage shall be cleaned before the surrounding or adjacent concrete is placed.

2. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations indicated or by Shop Drawings and shall be acceptable to the ENGINEER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.

E. Casting New Concrete Against Old: Where concrete is to be cast against old concrete (defined as any concrete which is greater than 60 Days of age), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting (exposing aggregate) prior to the application of an epoxy bonding agent. Application shall be according to the bonding agent manufacturer's instructions and recommendations.

F. No concrete shall be placed in any structure until water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes, or other means, and carried out of the forms, clear of the WORK. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, shall be subject to the review of the ENGINEER.

G. Corrosion Protection: Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to

placement of concrete that there will be a minimum of 2-inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

H. Openings for pipes, inserts for pipe hangers and brackets, and anchors shall, where practicable, be provided for during the placing of concrete.

I. Anchor bolts shall be accurately set and shall be maintained in position by templates while being embedded in concrete.

3.12 HANDLING, TRANSPORTING, AND PLACING

A. General: Placing of concrete shall conform to the applicable requirements of Chapter 8 of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.

B. Non-Conforming WORK or Materials: Concrete which during or before placing is found not to conform to the requirements indicated herein shall be rejected and immediately removed from the WORK. Concrete which is not placed in accordance with these Specifications or which is of inferior quality shall be removed and replaced.

C. Unauthorized Placement: No concrete shall be placed except in the presence of a duly authorized representative of the ENGINEER. The CONTRACTOR shall notify the ENGINEER in writing at least 24 hours in advance of placement of any concrete.

D. Conveyor Belts and Chutes: Ends of chutes, hopper gates, and other points of concrete discharge throughout the CONTRACTOR'S conveying, hoisting, and placing system shall be so designed and arranged that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the ENGINEER. Chutes longer than 50-feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the required consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. Conveyor belts and chutes shall be covered.

E. Temperature of Concrete: The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 40 degrees F in moderate weather, and not less than 50 degrees F in weather during which the mean daily temperature drops below 40 degrees F. Concrete ingredients shall not be heated to a temperature higher than that necessary to keep the temperature of the mixed concrete, as placed, from falling below the required minimum temperature. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means, such as precooling of aggregates and mixing water, using ice, or placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90 degrees F. The CONTRACTOR shall be entitled to no additional compensation on account of the foregoing requirements.

3.13 PUMPING OF CONCRETE

A. General: If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.

B. Pumping Equipment

1. The pumping equipment shall have 2 cylinders and be designed to operate with one cylinder only in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the Site during pumping.

2. The minimum diameter of the hose conduits shall be in accordance with ACI 304.2R - Placing Concrete by Pumping Methods.

3. Pumping equipment and hose conduits that are not functioning properly, shall be replaced.

4. Aluminum conduits for conveying the concrete shall not be permitted.

3.14 FINISHING CONCRETE SURFACES

A. General: Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions indicated are defined as tolerances and are indicated above. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. Formed Surfaces: No treatment is required after form removal except for curing, repair of defective concrete, and treatment of surface defects.

3.15 CURING AND DAMPPROOFING

A. **General:** Concrete shall be cured for not less than 7 Days after placing, in accordance with the methods indicated below for the different parts of the WORK.

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Construction joints between footings and walls, and between floor slab and columns	2
Encasement and ductbank concrete and thrust blocks	3
Concrete surfaces not specifically provided for elsewhere in this Paragraph	4
Buried slabs and backfilled walls	5

B. Method 1: Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removal. If steel forms are used, the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms

are removed within 7 Days of placing the concrete, curing shall be continued in accordance with Method 4 below.

C. Method 2: The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.

D. Method 3: The surface shall be covered with moist earth not less than 4 hours nor more than 24 hours after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 Days after placement of concrete.

E. Method 4: The surface shall be sprayed with a liquid curing compound.

1. It shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film that will seal thoroughly.

2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the 7 Day curing period. If the seal is damaged or broken before the expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

3. Wherever curing compound has been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.

4. Curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces, and within 2 hours after removal of forms. Repairs required to be made to formed surfaces shall be made within the said 2 hour period; provided, however, that any such repairs which cannot be made within the said 2 hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound.

5. During the curing period, no traffic of any nature and no depositing of any materials, temporary or otherwise, shall be permitted on surfaces coated with curing compound. Foot traffic and the depositing of materials may be allowed after 3 Days if the surface is covered with 5/8-inch plywood placed over polyethylene sheets.

F. Method 5: This method applies to both buried slabs and walls to be backfilled.

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 7 Days beginning immediately after the concrete has reached final set or forms have been removed.

2. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water through nozzles that atomize the flow so that the surface is not marred or washed.

3. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held substantially in contact with the concrete surface to prevent being dislodged by wind or any other causes. Edges shall be continuously held in place.

4. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.

5. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, any dry spots shall be rewetted, and curing compound shall be immediately applied in accordance with Method 4 above.

6. The CONTRACTOR shall dispose of excess water from the curing operation to avoid damage to the WORK.

7. Dampproofing: The exterior surfaces of buried roof slabs and backfilled walls shall be dampproofed as follows.

   a. Immediately after completion of curing, the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in 2 coats. The first coat shall be diluted to one-half strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the undiluted material, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon. Dampproofing material shall be as indicated above.

   b. As soon as the material has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used if it produces a uniformly coated white surface and remains until placing of the backfill. If the whitewash fails to remain on the surface until the backfill is placed, the CONTRACTOR shall apply additional whitewash

G. The CONTRACTOR may submit alternate methods of curing which maintain the concrete in a continuously wet condition for acceptance by the ENGINEER.

3.16 PROTECTION

A. The CONTRACTOR shall protect concrete against injury until final acceptance.

B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever precipitation is imminent or occurring.

3.17 TREATMENT OF SURFACE DEFECTS

A. As soon as forms are removed, exposed concrete surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as indicated below. Concrete containing extensive voids, holes, honeycombing, or similar depression defects, shall be completely removed and replaced. Repairs and replacements shall be performed promptly.

B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be

prepared for bonding by the removal of laitance or soft material, plus not less than 1/32-inch depth of the surface film from hard portions by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces underneath will remain moist but not so wet as to overcome the suction upon which a good bond depends. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of Atlas white portland cement as is required to make the color of the patch match the color of the surrounding concrete.

C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. These holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross-section, and other imperfections having a depth greater than their least surface dimension, shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.

D. Repairs shall be built up and shaped in such a manner that the completed WORK will conform to the requirements of this Section as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

3.18 CARE AND REPAIR OF CONCRETE

A. The CONTRACTOR shall protect concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, which becomes defective at any time prior to the final acceptance of the completed WORK, which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete.

END OF SECTION

SECTION 03 60 00 - GROUTING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents. For concrete repair material and procedures, reference Section 03 01 30 – Concrete Repair and Rehabilitation.

B. Grout provided as a base support for mechanical and electrical equipment shall conform to manufacturer's requirements and the requirements of this section.

C. The following types of grout are covered in this Section:

1. Non-Shrink Epoxy Grout

2. Topping Grout and Concrete/Grout Fill

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)

B. ASTM C307 -- Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacings

C. ASTM C531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

D. ASTM C579 – Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

E. ASTM C580 – Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

F. ASTM C827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures

G. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear

H. ASTM C1090 – Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout

I. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

J. ASTM C1116 – Standard Specification for Fiber-Reinforced Concrete

K. ASTM C1339 – Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

1. Certified testing lab reports for tests indicated herein.

2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.

3. Manufacturer’s literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use.

4. Documentation indicating that the grouts contain no chlorides or other chemicals that cause corrosion.

5. Manufacturer’s Safety Data Sheet documenting composition of grouts.

6. Submit manufacturer's written warranty as indicated herein.

7. Name and telephone number of grout manufacturer's representative who will give on-site service. The representative shall have at least one year of experience with the indicated grouts.

1.4 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the ENGINEER. The specimens will be made by the ENGINEER or its representative.

2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C1107 at intervals during construction selected by the ENGINEER.

3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 31 50 - Cast-in-Place Concrete at intervals during construction selected by the ENGINEER.

4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C579, Method B, at intervals during construction selected by the ENGINEER. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.

5. The cost of laboratory tests on grout will be paid by the OWNER except where test results show the grout to be defective. In such case, the CONTRACTOR shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the WORK.

6. The CONTRACTOR shall assist the ENGINEER in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.

B. Construction Tolerances: Construction tolerances shall be as indicated in Section 03 31 50 unless indicated otherwise.

C. Pre-Installation Demonstration and Training

1. Non-Shrink Grouts

a. The grout manufacturer shall give a demonstration and training session for the cement based and epoxy non-shrink grouts to be used on the project before any installation of grout is allowed.

b. The CONTRACTOR shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to the ENGINEER.

1.5 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. Manufacturer's Warranty

1. Furnish one year warranty for WORK provided under this section.

2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 -- PRODUCTS

2.1 APPLICATION

A. Unless indicated otherwise, grouts shall be provided as listed below whether indicated on the Drawings or not.

Application	Type of Grout
Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension.	Non-Shrink
Column base plates (greater than 2 story or larger than 16-inches in the least dimension)	High Strength Non-Shrink
Under precast concrete elements	High Strength Non-Shrink
Storage tanks and other non-motorized equipment or machinery under 30 horsepower	Non-Shrink
Motorized equipment over 30 horsepower and equipment under 30 horsepower but subject to severe shock loads and high vibrations	Non-Shrink Epoxy
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink
Toppings and concrete/grout fill less than 3-inches thick	Topping Grout

Toppings and concrete/grout fill greater than 3-inches thick	Sitework Concrete per 03 31 50
Anchor bolts, anchor rods and reinforcing steel required to be set in epoxy or adhesive.	Post Installed Anchors in Concrete per Section 05 05 19
Repair of holes and defects in concrete members.	Concrete Repair and Rehabilitation per Section 03 01 30

2.2 NON-SHRINK EPOXY GROUT

A. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents.

B. The manufacturer's product information shall state the acceptability of the epoxy grout for the intended purpose and location.

C. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

D. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable.

E. Non-shrink epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested in accordance with ASTM C531.

F. Non-shrink epoxy grout shall develop a minimum compressive strength of 9000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C579, method B.

G. The effective bearing area shall be a minimum of 85 percent effective bearing area (EBA) in accordance with ASTM C1339, for bearing area and flow.

H. The chemical formulation of the non-shrink epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.

I. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:

1. Minimum bond strength to concrete of 3000 psi per ASTM C882 modified.

2. Minimum bond strength to steel of 1700 psi per ASTM C882 modified.

3. Minimum flexural strength of 2500 psi per ASTM C580.

4. Minimum tensile strength of 2000 psi per ASTM C307.

J. Non-shrink epoxy grout shall be **Five Star DP Epoxy Grout** by **Five Star Products, Inc.**, **Masterflow 648** by **Master Builders**, **Sikadur 42 Grout-Pak** by **Sika Corporation**, or approved equal.

2.3 TOPPING GROUT AND CONCRETE/GROUT FILL

A. Where fill thickness is 3-inches or greater, structural concrete as indicated in Section 03 31 50 - Cast-in-Place Concrete, may be used when accepted by the ENGINEER. Fiber reinforcing shall be as indicated below.

B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tanks, channels, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as indicated. Materials and procedures indicated for structural concrete in Section 03 31 50 - Cast-in-Place Concrete, shall apply unless indicated otherwise.

C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water/cement ratio of 0.45.

D. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

E. Final mix design shall be as determined by trial mix design as indicated in Section 03 31 50, except that drying shrinkage tests are not required.

F. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 31 50.

G. Strength: Minimum compressive strength of topping grout and concrete/grout fill at 28 days shall be 4500 psi.

H. Topping grout used in clarifiers, or where the fill thickness is 3 inches or greater shall contain fiber reinforcing, unless otherwise shown on the Contract Documents. Fiber reinforcing shall be 100 percent virgin polypropylene fibrillated fibers specifically manufactured in a blended gradation for use as concrete secondary reinforcement. Fibers shall be added at a rate of 1.5 pounds per cubic yard of concrete. Fibers shall conform to ASTM C1116.

2.4 CURING MATERIALS

A. Curing materials shall be in accordance with Section 03 31 00 03 31 50 and as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

A. The consistency of grout shall be as necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

2.6 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Grout shall be stored in accordance with manufacturer's recommendations.

3.2 GENERAL

A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on-site technical assistance within 72 hours of request, as part of the WORK.

B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the ENGINEER.

C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.

D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 31 50. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.

E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.

F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.

G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.3 GROUTING PROCEDURES

A. General: Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.

1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the ENGINEER, alternate grouting methods shall be submitted by the CONTRACTOR for acceptance by the ENGINEER.

3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

C. Topping Grout and Concrete/Grout Fill

1. Mechanical, electrical, and finish WORK shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by the ENGINEER, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.

2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.

3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping grout and grout fill. No topping grout shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades

attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.

6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by the ENGINEER, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

3.4 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

END OF SECTION

SECTION 05 05 19 – POST-INSTALLED ANCHORS IN CONCRETE

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide post-installed anchors and appurtenances, complete and in place, as indicated in accordance with the Contract documents.

B. Unless otherwise indicated, drilled concrete anchors shall be adhesive anchors.

C. Section Includes:

1. Adhesive anchors

2. Expansion anchors

3. Screw anchors

4. Undercut anchors (dynamic loading)

1.2 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Definitions

1. Epoxy anchors are considered to be adhesive anchors.

2. Expansion anchors, screw anchors, and undercut anchors are considered to be mechanical anchors.

B. References

1. IBC 2019 – International Building Code

2. ACI 318 – Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary

3. ACI 355.2 – Qualification of Post Installed Mechanical Anchors in Concrete and Commentary (ACI 355.2-19).

4. ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7-16)

5. ICC ES AC 308 –Post Installed Adhesive Anchors in Concrete Elements

6. NSF 61 – NSF/ANSI 61-2016 Drinking Water System Components – Health Effects

1.3 SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Submit the following:

1. Product data and technical information

2. Safety Data Sheets (SDS) for adhesives

3. Manufacturer's literature containing installation instructions and appropriate uses for each type of post-installed anchor and location of use

4. Current ICC-ES or IAPMO-UES Evaluation Reports

5. Certification for each installer demonstrating that they have been qualified in accordance with the Quality Assurance requirements below

C. No substitution for the indicated anchors will be considered unless accompanied with an ICC-ES or IAPMO-UES report verifying strength and material equivalency.

D. Complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be completed and submitted in accordance with Section 01 33 17 – Structural Design, Support and Anchorage.

1. Where adhesive anchors are used for structural applications (such as dowels between new and existing concrete) and an embedment depth is not shown on the contract documents, the anchor shall be installed in accordance with Method 1 or Method 2 below:

a. Method 1: The minimum depth of embedment shall be greater than or equal to the development length (l_d) determined in accordance with ACI 318 for a cast in place reinforcing bar of the same diameter and grade, unless it can be shown by calculation that the anchor spacing and edge distance is sufficient to develop the tensile strength of the anchor in a lesser depth of embedment. Calculations shall be submitted in accordance with Section 01 33 00 – Contractor Submittals.

b. Method 2: Adhesive anchors in concrete that cannot develop the tensile capacity of the steel element may be used to transfer forces, provided that the loads on the anchor are amplified by the system overstrength factor (Ω_o) in Table 12.2-1 of ASCE 7-10, or where unreduced forces are used in accordance with ASCE 41-13 for existing structures. Calculations shall be submitted in accordance with Section 01 33 00 – Contractor Submittals.

1.4 QUALITY ASSURANCE

A. Special inspection for all post-installed anchor installations shall be provided:

1. As recommended or required by the ICC-ES or IAPMO-UES report.

2. As required by the enforceable building code.

3. As otherwise indicated in the Contract Documents.

B. The most stringent of the above requirements shall be used. The cost of Special Inspection of post-installed anchors shall be paid for by the OWNER.

C. Before installing adhesive anchors in the WORK, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading if required.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

D. Before installing mechanical anchors in the WORK, anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:

1. Hole drilling procedure, hole preparation and cleaning techniques, and torqueing.

2. Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.

E. Defective anchors noted by the Special Inspector shall be replaced and re-installed by the CONTRACTOR without any additional compensation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to job site in manufacturer’s or distributor’s packaging undamaged, complete with installation instructions.

B. Protect and handle materials in accordance with manufacturer’s recommendations to prevent damage or deterioration.

C. Anchoring adhesives shall be stored at temperatures prescribed by the manufacturer and must not be used beyond the expiration date.

1.6 SITE CONDITIONS

A. Post-installed anchors shall be installed in concrete having a minimum age of 21 days at time of anchor installation.

B. The anchor or fastener coating, plating, or steel type must provide suitable corrosion resistance for the environment in which the anchor or fastener is installed. Anchors, nuts, and washers in the locations listed below shall be fabricated from type 316 or 304 stainless steel:

1. chemical handling areas

PART 2 -- PRODUCTS

2.1 ADHESIVE ANCHORS

A. General

1. The adhesive anchor system shall consist of: 1) adhesive product; and 2) threaded rod or reinforcing bar insert. The complete system shall be compatible as required by the adhesive manufacturer.

2. Adhesives shall be injectable, two-component, cartridge-type systems dispensed and mixed through a static mixing nozzle supplied by the manufacturer.

3. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the adhesive anchor for the intended purpose and location.

4. Adhesive anchors shall be permitted when regular ambient temperatures are consistent with manufacturer's recommendation for long and short term temperatures.

5. Adhesive anchors shall not be used where anchors are subject to vibration or fire.

6. Adhesive anchors shall not be used in overhead applications.

7. Where required, adhesive shall be capable of being used in submerged applications once cured.

8. Adhesive shall meet the requirements of NSF/ANSI Standard 61.

B. Adhesive Anchors in Concrete

1. Threaded rod inserts shall meet the requirements of Section 05 50 00- Miscellaneous Metalwork.

2. Reinforcing dowel inserts shall meet the material requirements of Section 03 21 00 – Reinforcement Steel and 03 31 50 – Cast-in-Place Concrete.

3. Adhesive for use in concrete adhesive anchors shall be certified for use in resisting seismic loads in cracked concrete applications in accordance with ICC-ES AC 308.

4. Where not detailed on the drawings, adhesive anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC 308.

5. Adhesive anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and shall have been tested and qualified for performance in cracked and uncracked concrete in accordance ICC-ES AC308 to resist static, wind, and earthquake (Seismic Design Categories A through F).

6. Adhesive anchors for concrete shall be Pure110+ by DeWalt, HIT-RE 500 V3 by Hilti or SET-XP by Simpson Strong-Tie, or equal.

2.2 EXPANSION ANCHORS

A. General

1. Expansion anchors are post-installed torque-controlled mechanical expansion anchors used to resist structural loads.

2. Expansion anchors shall be an imperial sized, threaded stud with an integral cone expander, expansion clip, nut and washer.

3. Lead caulking anchors will not be permitted.

4. Non-embedded buried or submerged anchors shall be fabricated from stainless steel.

5. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the expansion anchor for the intended purpose and location.

6. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Expansion Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318, which requires post-installed mechanical anchors to be qualified according to ACI 355.2.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ACI 355.2 and ICC-ES AC193.

3. Expansion anchors shall be Strong-Bolt 2 by Simpson Strong-Tie, Kwik-Bolt TZ by Hilti, Power-Stud+ SD1 by DeWalt, or equal.

2.3 SCREW ANCHORS

A. General

1. Screw anchors used in exterior and corrosive environments shall be fabricated from stainless steel.

2. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the screw anchor for the intended purpose and location.

3. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

B. Screw Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC193.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ICC-ES AC193.

3. Screw anchors for concrete shall be Titen HD by Simpson Strong-Tie, Kwik HUS-EZ (KH-EZ) by Hilti, or equal.

2.4 UNDERCUT ANCHORS

A. General

1. Undercut anchors are post-installed mechanical anchors that require pre-drilling and a special undercut notch configuration cut into the concrete before installation.

2. Self-undercutting anchors are post-installed torque-controlled mechanical anchors that cut their own undercut notch by application of a setting torque that forces a sleeve over a cone.

3. The evaluation report issued by ICC-ES or IAPMO-UES shall state the acceptability of the undercut anchor for the intended purpose and location.

4. Anchors subjected to dynamic or vibratory loading shall be suitable for the intended loading and location as indicated in the manufacturer's technical product data.

5. Undercut anchors used in exterior and corrosive environments shall be fabricated from stainless steel.

B. Undercut Anchors for Concrete

1. Anchors shall be designed in accordance with ACI 318 as amended by the specific design provisions of ICC-ES AC193.

2. Anchors shall have an evaluation report issued by ICC-ES or IAPMO-UES and have been tested and qualified for performance in cracked and uncracked concrete in accordance with ACI 355.2 and ICC-ES AC193.

3. Undercut anchors for concrete shall be HDA by Hilti, Atomic+ by DeWalt, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Post-installed anchors shall be installed in strict accordance with the manufacturer's instructions, the ICC-ES or IAPMO-UES report, and project specific design requirements indicated on the Contract Documents or in the design calculations provided by the CONTRACTOR per Section 1.3.D.

B. Where holes are drilled in concrete, holes shall be accurately and squarely drilled, and the holes shall be cleaned in accordance with the manufacturer’s recommendations.

C. Post-installed anchors shall not be installed until the concrete has reached the required 21 days or per manufacturer’s requirements, whichever is longer.

D. Acceptable installation and performance temperature ranges shall be verified with manufacturer’s literature prior to installation. Minimum substrate temperatures shall be maintained during the full curing period as required by the manufacturer.

E. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

F. The CONTRACTOR shall identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

G. Core drilling of holes is not allowed.

H. Identification of reinforcing steel and/or embedded items, relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the WORK and shall be provided at no additional cost to the OWNER.

I. All abandoned drilled holes shall be repaired in accordance with Section 03 01 30 Concrete Repair and Rehabilitation at no additional cost to the OWNER.

END OF SECTION

SECTION 05 50 00 – MISCELLANEOUS METALWORK

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide miscellaneous metalwork and appurtenances, complete and in place, as indicated in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Federal Specifications

MIL-G-18015 A (3)	(Ships) Aluminum Planks. (6063-T6)
MIL-PRF-907F	Antiseize Thread Compound, High Temperature

B. Codes

OSHA 1927.10	Fixed Ladders

C. Commercial Standards

AA-M32C22A41	Aluminum Assn.
AASHTO HS-20	Truck Loading
AISC	Manual of Steel Construction
AISI	Design of Light Gauge, Cold-Formed Steel Structural Members
ASTM A 36	Carbon Structural Steel
ASTM A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 193	Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service
ASTM A 194	Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service
ASTM A 307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM F 1554	Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength
ANSI/AWS D1.1	Structural Welding Code - Steel
ANSI/AWS QC1	Qualification and Certification of Welding Inspectors

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 - Contractor Submittals.

B. Shop Drawings

1. Shop Drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the WORK.

2. Shop Drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.

C. Grating

1. Submit layout drawings for grating, showing the direction of span, type and depth of grating, size and shape of grating panels, seat angle details, and details of grating hold down fasteners.

2. Submit load and deflection tables for each style and depth of grating used.

D. Anchor Submittals

1. For post installed anchors in concrete other than powder-drive pins or impact anchors, refer to Section 05 05 19 – Post Installed Anchors in Concrete.

2. For powder-drive pins or impact anchors, complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be signed and stamped by a Professional Engineer registered in the state in which the project is located.

1.4 QUALITY ASSURANCE

A. Weld procedures and welder qualifications shall be available in the CONTRACTOR's field office for review.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Steel

Wide Flange Shapes	ASTM A 992
Shapes, Plates, Bars	ASTM A 36
Pipe, Pipe Columns, Bollards	ASTM A 53, Type E or S, Grade B standard weight unless indicated otherwise
HSS	ASTM A 500 Grade B

B. Corrosion Protection

1. Unless otherwise indicated, fabricated steel metalwork which will be used in a corrosive environment and/or will be submerged in water or wastewater shall be coated in accordance with the requirements of Section 09 96 00 - Protective Coating, and shall not be galvanized prior to coating.

2. Other miscellaneous steel metalwork shall be hot-dip galvanized after fabrication.

C. Stainless Steel

1. Unless otherwise indicated, stainless steel metalwork and bolts shall be fabricated from Type 316 stainless steel.

D. Aluminum

1. Unless otherwise indicated, aluminum metalwork shall be fabricated from Alloy 6061-T6.

2. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have contact surfaces coated in accordance with the requirements of Section 09 96 00 - Protective Coating.

E. Cast Iron

1. Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B, or better.

2.2 CHECKERED PLATE

A. Checkered plate shall be provided with a pattern of raised lugs on one face, and shall be smooth on the opposite face.

B. Lugs

1. Lugs shall be a minimum of one inch in length and raised a minimum of 1/2 inch above the surface.

2. The lugs shall be located in a pattern in which the lugs are oriented at 90 degrees from the adjacent lugs in 2 orthogonal directions.

3. The rows of lugs shall be oriented at 45 degrees from the edges of the plates.

C. Where no material is indicated, the plates shall be fabricated from aluminum.

D. Unless indicated otherwise, the minimum plate thickness shall be as required to limit deflection resulting from a live load of 100 psf to 1/4 inch, or the span divided by 240, whichever is less.

2.3 BOLTS AND ANCHORS

A. Standard Service (Non-Corrosive Application)

1. Bolts, anchor rods, anchor bolts, washers, and nuts shall be fabricated from steel as indicated.

2. Threads on galvanized bolts, rods and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing.

3. Except as otherwise indicated, steel for bolt material, anchor rods, anchor bolts, and cap screws shall be in accordance with the following requirements:

a. Structural Connections: ASTM A 307, Grade A or B, hot-dip galvanized

b. Headed Anchor Rods and Anchor Bolts: ASTM F1554, Grade 36, hot-dip or mechanically galvanized with Grade A matching nuts

c. High-Strength Bolts, where indicated: ASTM A 325

d. Pipe and Equipment Flange Bolts: ASTM A 193, Grade B-7

B. Corrosive Service

1. Bolts, anchor rods, anchor bolts, nuts, and washers in the locations listed below shall be fabricated from stainless steel as indicated.

a. buried locations

b. submerged locations

c. locations subject to seasonal or occasional flooding

d. inside hydraulic structures below the top of the structure

e. inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump

f. chemical handling areas

g. inside trenches, containment walls, and curbed areas

h. locations indicated or designated by the ENGINEER to be provided with stainless steel bolts

C. Unless otherwise indicated, stainless steel bolts, nuts, anchor rods, and washers shall be fabricated from Type 316 stainless steel, Class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts.

D. Coating

1. Threads on stainless steel bolts and rods shall be protected with an antiseize lubricant suitable for submerged stainless steel bolts, meeting government specification MIL-A-907E.

2. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

3. Antiseize lubricant shall be classified as acceptable for potable water use by the NSF.

4. Antiseize lubricant shall be "PURE WHITE" by **Anti-Seize Technology,** Franklin Park, IL, 60131, **AS-470** by **Dixon Ticonderoga Company,** Lakehurst, NJ, 08733, or equal.

E. Bolt Requirements

1. The bolt and nut material shall be free-cutting steel.

2. The nuts shall be capable of developing the full strength of the bolts.

3. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads.

4. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

5. Bolts and nuts shall be installed with washers fabricated from material matching the base material of bolts, except that hardened washers for high-strength bolts shall conform to the requirements of the AISC Specification.

6. Lock washers fabricated from material matching the bolts shall be installed where indicated.

7. The length of each bolt shall be such that the bolt extends at least 1/8 inch beyond the outside face of the nut before tightening, except for anchor bolts which shall be flush with the face of the nut before tightening.

2.4 POWDER-DRIVEN PINS

A. Powder-driven pins for installation in concrete or steel shall be fabricated from heat-treated steel alloy.

B. If the pins are not inherently sufficiently corrosion-resistant for the conditions to which they will be exposed, they shall be protected in an acceptable manner.

C. Pins shall have capped or threaded heads capable of transmitting the loads the shanks are required to support.

D. Pins that are connected to steel shall be provided with longitudinal serrations around the circumference of the shank.

2.5 IMPACT ANCHOR

A. Impact anchors shall be an expansion-type anchor in which a nail-type pin is driven to produce the expansive force.

B. The pin shall be provided with a zinc sleeve with a mushroom-style head and stainless steel nail pin.

C. Anchors shall be **Zinc Nailon Anchors**, manufactured by **Simpson Strong-Tie, Inc.**, **Metal Hit Anchors,** manufactured by **Hilti, Inc., Rawl Zamac Nailin,** manufactured by the **Rawlplug Company,** or equal.

PART 3 -- EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

A. **Fabrication and Erection:** Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

B. Aluminum Railings

1. Aluminum railing fabrication and installation shall be performed by craftsmen experienced in the fabrication of architectural metalwork.

2. Exposed surfaces shall be free from defects or other surface blemishes.

3. Dimensions and conditions shall be verified in the field.

4. Joints, junctions, miters, and butting sections shall be precision fitted with no gaps occurring between sections, and with surfaces flush and aligned.

5. Electrolysis protection of materials shall be provided.

C. Unless otherwise indicated, provide a 1/2-inch drain line to the nearest floor drain for floor hatches.

D. Powder-Driven Pins

1. Powder-driven pins shall be installed by a craftsperson certified by the manufacturer as being qualified to install the manufacturer's pins.

2. Pins shall be driven in one initial movement by an instantaneous force that has been carefully selected to attain the required penetration.

3. Driven pins shall conform to the following requirements where "D" is equal to the pin shank diameter:

Material Penetrated by Pin	Material Minimum Thickness	Pin Shank Penetration in Supporting Material	Minimum Space From Pin's CL to Edge of Penetrated Material	Minimum Pin Spacing
Concrete	16D	6D minimum	14D	20D
Steel	1/4-inch	Steel thickness	4D	7D

3.2 WELDING

A. Method

1. Welding shall be performed by the metal-arc method or gas-shielded arc method as described in the American Welding Society "Welding Handbook" as supplemented by other pertinent standards of the AWS.

2. The qualification of the welders shall be in accordance with the AWS Standards.

B. Quality

1. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained in order to minimize distortion and for control of dimensions.

2. Weld reinforcement shall be as indicated by the AWS Code.

3. Upon completion of welding, remove weld splatter, flux, slag, and burrs left by attachments.

4. Welds shall be repaired in order to produce a workmanlike appearance, with uniform weld contours and dimensions.

5. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32 inch on the flat.

3.3 GALVANIZING

A. Structural steel plates shapes, bars, and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123.

B. Any galvanized part that becomes warped during the galvanizing operation shall be straightened.

C. Bolts, anchor rods, anchor bolts, nuts, and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153.

D. Field Repairs

1. Field repairs to damaged galvanizing shall be performed by preparing the surface and applying a coating.

2. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.

3. The coating shall be applied to at least 3 mils dry film thickness, and shall be **Zinc-Clad XI** by **Sherwin-Williams**, **Galvax** by **Alvin Products**, **Galvite** by **ZRC Worldwide**, or equal.

END OF SECTION

SECTION 09 96 00 - PROTECTIVE COATING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide protective coatings, complete and in place, in accordance with the Contract Documents.

B. Definitions

1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.

2. The term "DFT" means minimum dry film thickness, without any negative tolerance.

C. The following surfaces shall not be coated:

1. Concrete, unless required by items on the concrete coating schedule below or the Drawings.

2. Stainless steel

3. Machined surfaces

4. Grease fittings

5. Glass

6. Equipment nameplates

7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

8. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.

D. The coating system schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the Drawings are used to show or extend the limits of coating schedules, to show exceptions to the schedules, or to clarify or show details for application of the coating systems.

E. Where protective coatings are to be performed by a Subcontractor, the Subcontractor shall possess a valid state license as required for performance of the painting and coating WORK called for in this specification and shall provide 5 references which show that the Subcontractor has previous successful experience with the indicated or comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the Subcontractor provided the protective coating.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Submittals shall include the following information and be submitted at least 30 Days prior to commencing protective coating WORK:

1. Materials List: Eight copies of a coating materials list showing the manufacturer and the product number, keyed to the coating systems herein. The list shall be submitted prior to or at the time of submitting samples.

2. Manufacturer's Information: For each coating system to be used, the following data:

a. Manufacturer's data sheet for each product proposed, including statements on the suitability of the material for the intended use.

b. Technical and performance information that demonstrates compliance with the system performance and material requirements.

c. Paint manufacturer's instructions and recommendations on surface preparation and application.

d. Colors available for each product (where applicable).

e. Compatibility of shop and field applied coatings (where applicable).

f. Material Safety Data Sheet for each product proposed.

C. Samples

1. Samples of paint, finishes, and other coating materials shall be submitted on 8-1/2 inch by 11-inch sheet metal. Each sheet shall be completely coated over its entire surface with one protective coating material, type, and color.

2. Two sets of color samples to match each color selected by the ENGINEER from the manufacturer's standard color sheets. If custom mixed colors are indicated, the color samples shall be made using color formulations prepared to match the color samples furnished by the ENGINEER. The color formula shall be shown on the back of each color sample.

3. One 5 pound sample of each abrasive proposed to be used for surface preparation for submerged and severe service coating systems.

D. Experience Requirements of the Field Applicator:

1. Three references which verify that the coating CONTRACTOR has demonstrated successful application of the specified coating system in the past 3 years. Provide the size (area of coating), time of completion, name, the owner’s address and telephone number for each installation referenced.

2. A written statement from the CONTRACTOR stating that they are qualified and experienced in the application of the specified coating systems. The letter shall state the manufacturer and model number of mixing, heating, and pumping equipment to be used to apply the specified coating systems.

3. A written statement from the manufacturer certifying that the coating CONTRACTOR's onsite foreman and each applicator performing WORK on the project has been trained and approved to apply the selected coating system.

4. CONTRACTOR shall provide SSPC QP 1 Certification or the manufacturer's certification of the applicator for the specified coating system.

E. Experience Requirements of the Shop Applicator

1. NACE Coating Inspector Program certification documents for the person responsible for Quality Assurance/Quality Control at the facility. This person will be responsible for submitting inspection reports to the OWNER.

2. A copy of a typical Quality Assurance/Quality Control inspection report containing items listed in 3.18 of this Specification.

3. Three references which verify that the shop painting facility has demonstrated successful application of the specified coating systems in the past 3 years. Provide the structure name and size (area of coating), time of completion, the owner's name, address, and telephone number for each installation referenced.

4. The manufacturer shall provide written certification that the shop painting facility's supervisor and each applicator performing Work on the project have been trained and approved by the manufacturer to apply the selected coating system.

5. The manufacturer shall state whether or not it has verified that the CONTRACTOR is going to use the proper mixing, coating application, heating, and environmental control equipment for the specified coating products. Only heated plural component equipment shall be used for the 100% solids coating application. Equipment shall be capable of performing a ratio test.

6. The Shop Coating Applicator shall provide SSPC QP 3 Certification or the coating manufacturer's certification of the applicator for selected coating system.

1.3 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS

A. Inspection: An inspection may be conducted during the eleventh month following completion of coating WORK. The CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. Defective WORK shall be repaired in accordance with these specifications and to the satisfaction of the OWNER. The OWNER may, by written notice to the CONTRACTOR, reschedule the inspection to another date within the one year correction period or may cancel the inspection altogether. The CONTRACTOR is not relieved of its responsibilities to correct defects, whether or not the inspection is conducted.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Suitability: The CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.

B. Material Sources: Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply

with VOC limits in effect at the time of Bid opening, that product will not be accepted, and the CONTRACTOR shall propose a substitution product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.

C. Compatibility: In any coating system only compatible materials from a single manufacturer shall be used in the WORK. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

D. Containers: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, and name of manufacturer, all of which shall be plainly legible at the time of use.

E. Colors: Colors and shades of colors of coatings shall be as indicated or selected by the ENGINEER. Each coat shall be of a slightly different shade to facilitate inspection of surface coverage of each coat. Finish colors shall be custom mixed to match color of piping and pumps currently installed.

F. Substitute or "Or-Equal" Products

1. To establish equality, the CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or-equal" product that the material meets the indicated requirements and is equivalent or better in the following properties:

    a. Minimum and maximum recoat times

    b. Minimum and maximum cure time for immersion

    c. Abrasion resistance per ASTM D4060 using CS17 Wheel

    d. Maximum and minimum dry film thickness per coat

    e. Compatibility with other coatings

    f. Suitability for the intended service

    g. Resistance to chemical attack

    h. Temperature limitations during application and in service

    i. Type and quality of recommended undercoats and topcoats

    j. Ease of application

    k. Ease of repairing damaged areas

    l. Stability of colors

2. Protective coating materials shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for

essentially identical service conditions. When requested, the CONTRACTOR shall provide the ENGINEER with the names of not less than 10 successful applications of the proposed manufacturer's products that comply with these requirements.

3. If a proposed substitution requires changes in the WORK, the CONTRACTOR shall bear such costs involved as part of the WORK.

2.2 INDUSTRIAL COATING SYSTEMS

A. System 4 - Epoxy/Polyurethane

1. Materials

Primer type	rust-inhibitive, 2 component epoxy
VOC Content, max	285 g/L
Finish type	2 component aliphatic polyurethane
VOC Content, max	300 g/L
Demonstrated suitable for	ferrous surfaces, superior color and gloss retention, exceptional resistance to weathering, chemical fumes, and splash

2. Application and manufacturers

Prime Coat (DFT = 3 - 5 mils)	Finish Coat (DFT = 3 - 4 mils)	TOTAL SYSTEM DFT
PPG- Amerlock 400/2	**PPG- Amershield**	6 - 9 MILS
Carboline Carboguard 893	**Carboline Carbothane 134 HG (2 coats)**	
Devoe Devran 224V	**Devoe Dethane 379H**	
Tnemec Hi-Build Epoxoline II Series L69	**TNEMEC SERIES 750UVX**	
Sherwin Williams Macropoxy 646	**Sherwin Williams Hi-Solids Polyurethane**	

B. System 8 - Epoxy, Equipment

1. Materials

Primer Type	2 component epoxy, recoatable up to one year
Demonstrated suitable for	Rust inhibitive, outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max	330
Finish Type	2 component epoxy, available in many colors
Demonstrated suitable for	Outstanding chemical, abrasion, and weathering resistance, resistance to splash, washdown, and condensation. Immersion capability is not required
VOC content, max	330

2. Application and manufacturers

Prime Coat (DFT = 4 to 6 mils)	FINISH COAT (DFT = 3 TO 4 MILS)	TOTAL SYSTEM DFT
PPG-Amerlock 400	**Amerlock 400**	7 to 10 mils
Tnemec Series L69	**Tnemec Series L69**	
Devoe Devran 224V	**Devran 224V**	

Carboline Carboguard 888	**Carboguard 888**	
Sherwin Williams Macropoxy 646	**S W Macropoxy 646**	

2.3 SUBMERGED AND SEVERE SERVICE COATING SYSTEMS

A. System 100 - Amine Cured Epoxy

1. Material

Type	high build, amine cure epoxy
VOC content, g/L max	220
Demonstrated suitable for	steel, long term immersion in water and wastewater, resistant to corrosion, chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	**Total System DFT**
PPG- Amercoat 133	15 to 17 mils For non-submerged valves and other equipment, DFT = 10 to 12 mils
Carboline Carboguard 891HS	
International Bar-Rust 233H	
Tnemec Epoxoline Series L69	
Sherwin Williams Macropoxy 646 PW	

B. System 101 - (Not used)

C. System 102 - Polyamide Epoxy

1. Materials

Type	high build polyamide cure epoxy
VOC content, max, g/L	366
Demonstrated suitable for	long term immersion in water and wastewater, resistant to corrosion and chemical fumes, good color retention
Certification	NSF 61 if in contact with potable water

2. Application and manufacturers

Products (3 coats or more)	**Total System DFT**
PPG- Amercoat 370	11 - 13 mils
Tnemec Pota-Pox Series 20	
Carboline Carboguard 61	
Sherwin Williams Macropoxy 646 PW for water and Dura-Plate 235 for wastewater	
Devoe Bar-Rust 233H	

D. System 106 - Fusion Bonded Epoxy

1. Material

Type	100 percent solids fusion bond epoxy
Demonstrated suitable for	fluidized bed or electrostatic spray application, recommended for pumps, valves, pipe appurtenances, tanks, pipe hangers, flow meters, and hydrants
Certification requirement	NSF 61

2. Application in accordance with AWWA C213 and the following:

Product	Surface and DFT
3M Scotchkote 134 or 206N	Valves 12-mils
	All others 16-mils

PART 3 -- EXECUTION

3.1 MANUFACTURER'S SERVICES

A. The CONTRACTOR shall require the protective coating manufacturer to furnish a qualified technical representative to visit the Site for technical support as may be necessary to resolve field problems.

B. For submerged and severe service coating systems, the CONTRACTOR shall require the paint manufacturer to furnish the following services:

1. The manufacturer's representative shall provide at least 4 hours of on-Site instruction in the proper surface preparation, use, mixing, application, and curing of the coating systems.

2. The manufacturer's representative shall observe the start of surface preparation, mixing, and application of the coating materials for each coating system.

3.2 WORKMANSHIP

A. Skilled craftsmen and experienced supervision shall be used on coating WORK.

B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.

C. Damage to other surfaces resulting from the WORK shall be cleaned, repaired, and refinished to original condition.

3.3 STORAGE, MIXING, AND THINNING OF MATERIALS

A. Manufacturer's Recommendations**:** Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.

B. Coating materials shall be used within the manufacturer's recommended shelf life.

C. Storage and Mixing: Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

3.4 PREPARATION FOR COATING

A. General: Surfaces to receive protective coatings shall be prepared as indicated prior to application of coatings. The CONTRACTOR shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up

restoration prior to any field coating application. Surfaces to be coated shall be dry and free of visible dust.

B. Protection of Surfaces Not to be Coated: Surfaces that are not to receive protective coatings shall be protected during surface preparation, cleaning, and coating operations.

C. Hardware, lighting fixtures, switch plates, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not to be painted shall be removed, masked, or otherwise protected. Drop cloths shall be provided to prevent coating materials from falling on or marring adjacent surfaces. The working parts of mechanical and electrical equipment shall be protected from damage during surface preparation and coating operations. Openings in motors shall be masked to prevent entry of coating or other materials.

D. Care shall be exercised not to damage adjacent WORK during blasting operations. Spraying shall be conducted under carefully controlled conditions. The CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent WORK or adjoining property occurring from blasting or coating operations.

E. Protection of Painted Surfaces: Cleaning and coating shall be coordinated so that dust and other contaminants from the preparation process will not fall on wet, newly-coated surfaces.

3.5 ENVIRONMENTAL REQUIREMENTS

A. No coating work shall be performed under the following conditions:

1. Surface or ambient temperatures exceed the manufacturer's recommended maximum or minimum allowable.

2. Dust or smoke laden atmosphere.

3. Damp or humid conditions, where the relative humidity is above the manufacturer's maximum allowable.

4. Substrate and ambient temperatures are less than 5°F above the dew point and are decreasing. Dew point shall be measured by use of an instrument such as a Sling Psychrometer in conjunction with U.S. Department of Commerce, Weather Bureau psychrometric tables. Elcometer 319 Dew Point meter or equal may also be used.

5. Ambient temperature that is expected to drop below 50°F or less than 5°F above the dew point within 8 hours after application of coating.

3.6 SURFACE PREPARATION STANDARDS

A. The following referenced surface preparation specifications of the Steel Structures Painting Council shall form a part of this specification:

1. Solvent Cleaning (SSPC SP 1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.

2. Hand Tool Cleaning (SSPC SP 2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.

3. Power Tool Cleaning (SSPC SP 3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.

4. White Metal Blast Cleaning (SSPC SP 5/NACE 1): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.

5. Commercial Blast Cleaning (SSPC SP 6/NACE 3): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.

6. Brush-Off Blast Cleaning (SSPC SP 7/NACE 4): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.

7. Near-White Blast Cleaning (SSPC SP 10/NACE 2): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.

8. Power Tool Cleaning to Bare Metal (SSPC 11) When viewed without magnification, the surface shall be free of all visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter. Slight residues of rust and paint may be left in the lower portion of pits if the original surface is pitted. The surface profile shall not be less than 1 mil (25 microns).

9. Surface Preparation of Concrete (SSPC-SP 13/NACE 6): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.

3.7 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)

A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

B. The Shop Painting Facility shall use a minimum blast material mixture of 75% grit and 25% shot material to achieve the proper surface profile.

C. The Field Coating Applicator shall abrasive blast the shop coated surfaces per SSPC SP 7/NACE 4. The previously shop-painted surfaces shall be abraded prior to the application of the final coats. Special attention shall be given to uncoated steel weld joints, coating holdbacks, and bare metal.

D. Grease, oil, and welding fluxes shall be removed by wiping with MEK or naphtha cleaning or with trisodium phosphate detergent per SSPC SP 1.

E. All sharp edges shall be rounded or chamfered and all burrs, rust, scale, welding slag, and spatter shall be removed and the surface prepared by SSPC SP 2 hand tool cleaning, and SSPC SP 3 power tool cleaning.

F. The Contractor shall test the surfaces for soluble salts with the use of Chlor*Test as manufactured by Chlor*Rid International or approved equivalent. Any blasted surfaces shall be tested and shall have a maximum concentration of 5 micrograms per square centimeter (µg/cm^2). A test shall be conducted for every 100 square feet (ft2) of surface area to be coated at locations determined by the Inspector.

G. If the soluble salt test indicates chloride concentrations greater than those outlined in these Specifications, the Contractor shall use Chlor*Rid, as manufactured by Chlor*Rid International, in the water source during Water Cleaning to remove the salts from the substrate. A substrate's surface preparation will be accepted once the soluble salt concentration is below the amounts outlined in these Specifications.

H. The type and size of abrasive shall be selected to produce a surface profile that meets the coating manufacturer's recommendation for the particular coating and service conditions.Abrasive shall not be reused unless an automated blasting system is used for surfaces that will be in non-submerged service. For automated blasting systems, clean oil-free abrasives shall be maintained. The abrasive mix shall include at least 50 percent grit.

I. The CONTRACTOR shall comply with the applicable federal, state, and local air pollution control regulations for blast cleaning.

J. Compressed air for air blast cleaning shall be supplied at adequate pressure from well-maintained compressors equipped with oil and moisture separators that remove at least 95 percent of the contaminants.

K. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.

L. Enclosed areas and other areas where dust settling is a problem shall be vacuum-cleaned and wiped with a tack cloth.

M. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.

N. If the required abrasive blast cleaning will damage adjacent WORK, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP 2 or SSPC SP 3 may be used.

O. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP 1 before the abrasive blast cleaning has been started.

P. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.

3.8 FERROUS METAL SURFACE PREPARATION (GALVANIZED)

A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP 1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by brush off blast cleaning per SSPC SP 7/NACE 4.

B. Any high spots, sharp protrusions, and rough edges, such as the metal drip line, shall be smoothed to avoid paint film gaps in the areas of the high spots. Surfaces shall be hand tool cleaned per SSPC SP 2 and power tool cleaned per SSPC SP 3.

C. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer. Galvanized metals may be cleaned with suitable organic solvent such as a rust inhibitor or aqueous alkaline solution per ASTM D6386.

D. The surfaces of galvanized steel exposed to chemical splashing or within a wastewater head space shall be abraded per SSPC SP 11 or SP 7 prior to coating.

3.9 SURFACE PREPARATION OF FERROUS SURFACES WITH EXISTING COATINGS, EXCLUDING STEEL RESERVOIR INTERIORS

A. General: Grease, oil, heavy chalk, dirt, or other contaminants shall be removed by solvent or detergent cleaning prior to abrasive blast cleaning. The generic type of the existing coatings shall be determined by laboratory testing.

B. Abrasive Blast Cleaning: The CONTRACTOR shall provide the degree of cleaning indicated in the coating system schedule for the entire surface to be coated. If the degree of cleaning is not indicated in the schedule, deteriorated coatings shall be removed by abrasive blast cleaning to SSPC SP 6/NACE 3. Areas of tightly adhering coatings shall be cleaned to SSPC SP 7/NACE 4, with the remaining thickness of existing coating not to exceed 3-mils.

C. Incompatible Coatings: If coatings to be applied are not compatible with existing coatings the CONTRACTOR shall apply intermediate coatings per the manufacturer's recommendation for the indicated coating system or shall completely remove the existing coating prior to abrasive blast cleaning. A small trial application shall be conducted for compatibility prior to painting large areas.

D. Unknown Coatings: Coatings of unknown composition shall be completely removed prior to application of new coatings.

E. Water Abrasive or Wet Abrasive Blast Cleaning: Where indicated or where Site conditions do not permit dry abrasive blasting for industrial coating systems due to dust or air pollution considerations, water abrasive blasting or wet abrasive blasting may be used. In both methods, paint-compatible corrosion inhibitors shall be used, and coating application shall begin as soon as the surfaces are dry. Water abrasive blasting shall be done using high pressure water with sand injection. In both methods, the equipment used shall be commercially produced equipment with a successful service record. Wet blasting methods shall not be used for submerged or severe service coating systems unless indicated.

3.10 PLASTIC, FIBER GLASS AND NONFERROUS METALS SURFACE PREPARATION

A. Plastic and fiber glass surfaces shall be sanded or brush off blast cleaned prior to solvent cleaning with a chemical compatible with the coating system primer.

B. Non-ferrous metal surfaces shall be solvent-cleaned SSPC SP 1 followed by sanding or brush-off blast cleaning SSPC SP 7/NACE 4.

C. Surfaces shall be clean and dry prior to coating application.

3.11 SHOP COATING REQUIREMENTS

A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires top coating within a specific period of time, the equipment shall be finish-coated in the shop and then be touched up after installation.

B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.

C. Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning all surfaces as necessary in accordance with SSPC SP 1 and SP 2. Damaged shop coating shall be cleaned in accordance with SSPC SP 3, Power Tool Cleaning, and recoated with the primer specified.

D. For every 500 square feet, or less, of steel surface blasted, the surface profile shall be tested with the use of Press-o-Film as manufactured by Testex, or other RP0287 approved equal, at locations to be determined by the Inspector. The replica tape thickness shall be measured using a dial micrometer manufactured by Testex, or other ASTM D4417 Type C approved equal. For each test area, one replica tape test shall be performed. For each test area, the three replica tape thickness values shall be recorded and must be within 10% of the coating manufacturer's recommended profile. If the surface profile does not meet the manufacturer's recommended profile, two additional tests will be performed within a 12-inch diameter of the initial test. If the values are not satisfactory, the Contractor shall reblast the affected areas.

E. The interior surfaces of steel water reservoirs, except for Paragraph A surfaces, shall have surface preparation and coating WORK performed in the field.

F. For certain pieces of equipment it may be undesirable or impractical to apply finish coatings in the field. Such equipment may include engine generator sets, equipment such as electrical control panels, switchgear or main control boards, submerged parts of pumps, ferrous metal passages in valves, or other items where it is not possible to obtain the indicated quality in the field. Such equipment shall be primed and finish-coated in the shop and touched up in the field with the identical material after installation. The CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.

G. For certain small pieces of equipment the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.

H. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being top coated or less time if recommended by the coating manufacturer.

I. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

J. The CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.

3.12 APPLICATION OF COATINGS

A. The application of protective coatings to steel substrates shall be in accordance with SSPC PA1 - Paint Application Specification No. 1.

B. Cleaned surfaces and each coat shall be inspected prior to applying each succeeding coat. The CONTRACTOR shall schedule such inspection with the ENGINEER in advance.

C. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.

D. Coatings shall be applied in accordance with the manufacturer's instructions and recommendations and this Section, whichever has the most stringent requirements.

E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. CONTRACTOR shall use an independent stripe coat per SSPC PA Guide 11 for these areas. Particular care shall be used to ensure that the specified coverage is secured on the edges and corners of all surfaces.

F. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.

G. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.

H. Coatings shall not be applied under the following conditions:

1. Temperatures exceeding the manufacturer's recommended maximum and minimum allowable.

2. Concrete surfaces will be in direct sunlight during application or within 3 hours after application.

3. Dust or smoke laden atmosphere.

4. Damp or humid weather.

5. Substrate or air temperature is less than 5 degrees F above the dew point.

6. Air temperature is expected to drop below 40 degrees F or less than 5 degrees F above the dew point within 8 hours after application of coating.

7. Wind conditions are not calm.

I. Dew point shall be determined by use of a sling psychrometer in conjunction with U.S. Dept. of Commerce, Weather Bureau psychometric tables.

J. Unburied steel piping shall be abrasive blast cleaned and primed before installation.

K. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

3.13 CURING OF COATINGS

A. The CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.

B. In the case of enclosed areas, forced air ventilation, using heated air if necessary, may be required until the coatings have fully cured.

C. **Forced Air Ventilation of Steel Reservoirs and Enclosed Hydraulic Structures, Including Dry Wells of Pump Stations:** Forced air ventilation is required for the application and curing of coatings on the interior surfaces of steel reservoirs and enclosed hydraulic structures. During application and curing periods, continuously exhaust air from a manhole in the lowest shell ring, or in the case of an enclosed hydraulic structure, from the lowest level of the structure using portable ducting. After interior coating operations have been completed, provide a final curing period for a minimum of 5 Days or as recommended by coating manufacturer, during which the forced ventilation system shall operate continuously. For additional requirements, refer to the specific coating system requirements in Part 2 above.

3.14 SHOP AND FIELD INSPECTION AND TESTING

A. General: The CONTRACTOR shall give the ENGINEER a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.

B. Such WORK shall be performed only in the presence of the ENGINEER, unless the ENGINEER has granted prior approval to perform such WORK in its absence.

C. Inspection by the ENGINEER, or the waiver of inspection of any particular portion of the WORK, shall not relieve the CONTRACTOR of its responsibility to perform the WORK in accordance with these Specifications.

D. Scaffolding shall be erected and moved to locations where requested by the ENGINEER to facilitate inspection. Additional illumination shall be furnished on areas to be inspected.

E. Inspection Devices: The CONTRACTOR shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for the ENGINEER's use while coating is being done, until final acceptance of such coatings. The CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the ENGINEER.

F. Holiday Testing: The CONTRACTOR shall test for continuity all coated ferrous surfaces inside a steel reservoir, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then be retested.

1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as **Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20,** or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.

2. Coatings with thickness of 20-mils or less total DFT: **Tinker & Rasor Model M1** non-destructive type holiday detector, **K-D Bird Dog,** or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a non-sudsing type wetting agent, such as **Kodak Photo-Flo** or equal, shall be added to the water prior to wetting the detector sponge.

G. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC Paint Application Specification No. 2 using a magnetic type dry film thickness gauge such as **Mikrotest Model FM, Elcometer Model 111/1EZ,** or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.

H. Surface Preparation: Confirm proper surface profile with Testex Press-O-Film replica tape in accordance with NACE RP0287-02.

3.15 Coating System Schedule, Ferrous Metal - Not Galvanized

	Item	Surface Prep.	System No.
FM-1	All surfaces indoors and outdoors, exposed or covered, except those included below.	Commercial blast cleaning SSPC SP 6/NACE 3	(4) epoxy/ polyurethane
FM-3	Surfaces of equipment and piping (excluding shop-coated valves, couplings, pumps).	White metal blast cleaning SSPC SP 5/NACE 1	(100) amine cure epoxy
FM-7	Pump suction straightening vanes and spool piece.	Solvent cleaning SSPC SP 1, followed by white metal blast cleaning SSPC-SP 10/NACE 2	(106) fusion bond epoxy
FM-9	Ferrous surfaces of sleeve couplings.	Solvent cleaning SSPC SP 1, followed by white metal blast cleaning SSPC-SP 10/NACE 2	(106) fusion bond epoxy
FM-10	All ferrous surfaces of sluice gates, flap gates, and shear gates, including wall thimbles.	White metal blast cleaning SSPC SP 5/NACE 1	(102) polyamide epoxy
FM-15	Structural steel, miscellaneous metalwork	--	Refer to Structural Specifications
FM-16	Surfaces of indoor equipment, not submerged	Commercial blast cleaning SSPC SP 6/NACE 3	(8) epoxy, equipment
FM-17	Existing exposed raw sewage piping for pumps #2 and #4 as indicated.	Commercial blast cleaning SSPC SP 6/NACE 3	(100) amine cure epoxy

3.16 Coating System Schedule, Ferrous Metal - Galvanized: Pretreatment coatings, barrier coatings, or washes shall be applied as recommended by the coating manufacturer. All galvanized surfaces shall be coated except for the following items which shall be coated only if required by other Sections: (1) Floor gratings and frames, (2) Handrails, (3) Stair treads, (4) Chain link fencing and appurtenances.

END OF SECTION

SECTION 26 00 00 – ELECTRICAL WORK, GENERAL

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide the electrical WORK, complete and operable, as indicated in accordance with the Contract Documents.

B. The provisions of this Section shall apply to all Sections in Division 26, except as otherwise indicated.

C. The WORK of this Section is required for operation of electrically-driven equipment provided under Specifications in other Divisions.

D. The CONTRACTOR'S attention is directed to the requirement for proper coordination of the WORK of this Section with the WORK of equipment Specifications, the WORK of instrumentation Sections, and the WORK of Section 26 05 10 – Electric Motors.

E. Concrete, and steel reinforcement required for encasement, installation, or construction of the WORK of the various Sections of Division 26 is included as a part of the WORK under the respective Sections, including equipment housekeeping pads.

F. Equipment supports and foundations shall be in conformance with the requirements of Section 01 33 17 - Structural Design, Support and Anchorage , and 05 05 19 - Post-Installed Anchors in Concrete.

1.2 REFERENCE STANDARDS

NEC (NFPA 70)	National Electrical Code: 2020 edition
NETA	International Electrical Testing Association
NEMA 250	Enclosure for Electrical Equipment (1000 Volts Maximum)

A. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.

B. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 CFR 1926, as applicable), state building standards, and applicable local codes and regulations.

C. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE AND MARKINGS

A. Identification

1. Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal, state, OSHA, and NEC requirements.

B. Local Disconnect Switches

1. Legibly mark each local disconnect switch for motors and equipment in order to indicate its purpose, unless the purpose is indicated by the location and arrangement.

C. Warning Signs

1. 600 Volts Nominal, or Less

a. Mark entrances to rooms and other guarded locations that contain live parts with conspicuous signs prohibiting unqualified persons from entering.

2. Mark indoor electrical installations that are open to unqualified persons and contain metal-enclosed switchgear, unit substations, transformers, and other similar associated equipment over 600 volts nominal, with appropriate caution signs.

3. Outside Branch Circuits and Feeders over 600 Volts

a. Post warning signs in plain view where unauthorized persons might come in contact with live parts: WARNING – HIGH VOLTAGE – KEEP OUT.

D. Isolating Switches

1. Provide isolating switches not interlocked with an approved circuit-interrupting device with a sign warning against opening them under load.

1.4 PERMITS AND INSPECTION

A. Obtain permits and pay inspection fees according to the General Conditions.

1.5 CONTRACTOR SUBMITTALS

A. General

1. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

2. Custom-prepare Shop Drawings.

3. Drawings or data indicating "optional" or "as required" equipment will not be accepted.

4. Cross out options not proposed or delete from the Shop Drawings.

5. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Shop Drawings: Include the following:

1. Complete material lists stating manufacturer and brand name of each item or class of material.

2. Shop Drawings for grounding WORK not specifically indicated

3. Front, side, rear elevations, and top views with dimensional data

4. Location of conduit entrances and access plates

5. Component data

6. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size, and cable numbers

7. Method of anchoring, seismic requirements, weight

8. Types of materials and finish

9. Nameplates

10. Temperature limitations, as applicable

11. Voltage requirement, phase, and current, as applicable

12. Front and rear access requirements

13. Test reports

14. Grounding requirements

C. Catalog Cuts

1. Submit catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced, non-custom manufactured material.

2. Stamp the catalog data sheets in order to indicate the Project name, applicable Specifications Section and Paragraph, model number, and options.

D. Materials and Equipment Schedules

1. Within 30 Days of the commencement date in the Notice to Proceed, deliver to the ENGINEER a complete list of materials, equipment, apparatus, and fixtures that are proposed for use.

2. Include in the list the type, size, name of manufacturers, catalog number, and such other information as required to identify the item.

E. Technical Manuals

1. Submit complete information in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

2. As-Built Drawings

a. Furnish the drawings to the ENGINEER in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

1.6 AREA DESIGNATIONS

A. General

1. Designations for raceway system enclosures shall comply with the requirements of Section 26 05 33 – Electrical Raceway Systems.

2. Designations for electrical WORK specifically indicated in other Sections shall comply with the requirements of those Sections unless indicated otherwise.

3. Designations for other electrical WORK not included in the above Paragraphs shall be as follows:

AREA	NEMA ENCLOSURE CLASSIFICATION					
	1	3R	7	4X	12	Notes
Influent Pump Station (IPS)- Wet Well			X			There is no Division 26 WORK required in the Wet Well under this Contract.
Influent Pump Station (IPS)- grade floor (VFD) level, motor level, pump room				X		

4. Designations for electrical WORK not included in the above Paragraphs shall be NEMA 4X.

B. Material Requirements

1. Construct NEMA 4X enclosures of Type 316 stainless steel.

2. Do not coat NEMA 4X enclosures.

3. Construct NEMA 1, 3R, and 12 enclosures of steel, and prime and coat with ANSI 61 light grey paint.

C. Location Definitions

1. General Purpose Locations: Work installed in areas defined as NEMA 1 Areas above shall be considered General Purpose Locations. These areas are indoor, dry locations.

2. Indoor Damp/Indoor Wet/Outdoor/Corrosive Locations: Work installed in areas defined as NEMA 4X areas above shall be considered as Indoor Damp/Indoor Wet/Outdoor/Corrosive Locations

1.7 TESTS

A. The CONTRACTOR shall be responsible for factory and field tests indicated in Division 26, as required by the ENGINEER, and as required by other authorities having jurisdiction.

B. Furnish necessary testing equipment.

C. Pay the costs of the tests, including replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of a faulty installation.

D. Reporting

1. Where test reporting is indicated, submit proof-of-design test reports for mass-produced equipment with the Shop Drawings.

2. Submit factory performance test reports for custom-manufactured equipment for approval prior to shipment.

3. Submit field test reports for review prior to Substantial Completion.

E. Remove and replace equipment or material that fails a test, or, if the ENGINEER approves, repair and retested for compliance.

F. Corrections to equipment or materials with a factory warranty shall be as recommended by the manufacturer and shall be performed in a manner that does not void the warranty.

1.8 DEMOLITION AND RELATED WORK

A. General

1. Perform electrical demolition WORK as indicated.

2. The CONTRACTOR is cautioned that demolition WORK may also be indicated on non-electrical Drawings.

3. Coordinate with all trades regarding electrical de-energization, disconnection, and removal, and the overall sequence of construction.

B. Electrical Requirements for Removed Equipment

1. Remove dedicated wiring and exposed conduits back to the source.

2. Abandon in place wiring that shares conduits with other equipment wiring, except power wiring.

3. Remove power wiring from the power source to the first pullbox, junction box or manhole remote from the panel, and abandon in place the remaining wiring.

4. Encased Conduits

a. Abandon in place wiring routed through encased conduits.

b. Remove exposed conduit to the first fitting/coupling before encasement. Remove the fitting/coupling and replace with a 5-thread conduit cap.

C. Junction Boxes

1. Wiring and conduits indicated to be extended shall be terminated in a new junction box with terminal strips.

2. Provide a junction box with a NEMA rating in accordance with the area in which it is located, and sized as required.

3. Properly identify wires and terminals before disconnection.

D. The OWNER maintains the right of first refusal on all loose items. The removed materials and equipment not indicated to be returned to the OWNER shall, upon removal, become the CONTRACTOR'S property and shall be disposed of off- Site.

E. Remove and relocate material and equipment indicated to be relocated or reused, and reinstall with care in order to prevent damage.

F. Place materials indicated to be returned to the OWNER in boxes, with the contents clearly marked, and store at a location determined by the ENGINEER.

G. Identification

1. Where motor control centers and panelboards are indicated to have components, assemblies, or circuits removed and reconnected, provide the affected MCC compartments with new engraved nameplates worded as indicated and matching the existing, or modify the panelboard schedule to indicate the revised circuits.

2. Pencil or magic marker markings directly on the MCC or panelboard breaker will not be accepted.

1.9 CONSTRUCTION SEQUENCING

A. General

1. Because the continuance of plant operation during the expansion process is critical, the CONTRACTOR shall carefully examine the WORK to be provided in, on, or adjacent to existing equipment.

2. Schedule the WORK, subject to OWNER's approval, to minimize required shutdown time.

3. Submit a written sequencing request, including the sequence and duration of activities to be performed during plant shutdown.

4. Switching, safety tagging, and the like, as required for plant shutdown or to isolate existing equipment, shall be performed by the CONTRACTOR following permission from the OWNER.

5. In no case shall the CONTRACTOR begin any WORK in, on, or adjacent to existing equipment without written authorization from the ENGINEER.

B. Modifications

1. Perform modifications or alterations to existing electrical facilities as required to successfully install and integrate the proposed electrical equipment as indicated.

2. Perform modifications to existing equipment, panels, and cabinets in a professional manner.

3. Repair coatings to match existing.

4. The costs for modifications to existing electrical facilities that are required for a complete and operating system shall be included as part of the WORK.

C. Field Verifications

1. Visit the Site before submitting a Bid to become better acquainted with the WORK of this Contract.

2. The lack of knowledge will not be accepted as justification for extra compensation to perform the WORK.

3. The cost for the above verifications shall be included as part of the WORK.

D. Installation of Temporary Equipment

1. To facilitate the continuous operation of existing equipment, provide the temporary equipment as indicated.

2. Submit installation and connection details for review and acceptance by the ENGINEER.

3. Costs associated with these temporary installations shall be included as part of the WORK.

4. Temporary wiring and equipment shall remain the property of the CONTRACTOR unless indicated otherwise.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Provide equipment and materials that are new and are the products of experienced and reputable manufacturers in the industry.

B. Provide equipment and materials listed by UL and bearing the UL label, where UL requirements apply.

C. Provide similar items in the WORK as products of the same manufacturer.

D. Provide equipment and materials of industrial grade standard of construction.

E. Where a NEMA enclosure type is indicated modifications such as cutouts for control devices shall maintain the NEMA rating.

F. On devices indicated to display dates, display the year as 4 digits.

G. Temperature Ratings of Equipment Terminations

1. Provide terminations and lugs rated for use with 75-degree C conductors.

2. Wire sizes in the Contract Documents are based on NEC ampacity tables using the 75-degree C ratings.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware

1. Provide nuts, bolts, and washers constructed of stainless steel.

2. Provide threaded rods for trapeze supports constructed from continuous threaded stainless steel, 3/8-inch diameter minimum.

3. Struts

    a. Construct struts for mounting of conduits and equipment of stainless steel.

    b. Where contact with concrete or dissimilar metals may cause galvanic corrosion, use suitable non-metallic insulators in order to prevent such corrosion.

    c. Strut Manufacturer, or Equal: **Unistrut**; **B-Line**

4. End Caps

    a. Provide plastic protective end caps for all exposed strut ends.

    b. End Caps Manufacturer, or Equal: **Unistrut, Model P2860**

5. Anchors

    a. Provide stainless steel expansion anchors for attaching equipment to concrete walls, floors, and ceilings.

    b. Wood plugs will not be accepted.

    c. Anchor Manufacturer, or Equal: **"Power-Bolt"** or **"Power-Stud"** as manufactured by **Power Fasteners, Inc.**; similar by **Hilti** or **Star**.

2.3 ELECTRICAL IDENTIFICATION

A. Nameplates and Equipment Identification

1. Fabricate nameplates from white-letter, black-face laminated plastic engraving stock, such as **Formica Type ES-1** or equal.

2. Securely fasten each nameplate, using fasteners constructed of brass, cadmium-plated steel, or stainless steel, and screwed into inserts or tapped holes as required.

3. Provide engraved characters of the block style, with no characters smaller than 1/8 inch top to bottom.

B. Conductor Identification

1. Conductors size No. 10 AWG or smaller shall have identification sleeves. Conductors size No. 8 AWG and larger shall use cable markers of the locking tab type. Tabs shall be white plastic with conductor identification number permanently embossed. Adhesive strips are not acceptable.

2. The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink with figures 1/8 inch high. Sleeve shall be yellow or white tubing and sized to fit the conductor insulation. Shrink the sleeves with hot ir after installation to fit the conductor.

3. Provide conductor identification as follows:

a. TMS Thermofit Marker System by Raychem CO

b. Sleeve style wire marking system by Brady,

c. or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. Incidentals

1. Provide materials and incidentals required for a complete and operable system, even if not required explicitly by the Contract Documents.

2. Typical incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor-furnished equipment to connect with other equipment indicated in the Contract Documents.

B. Field Control of Location and Arrangement

1. The Drawings diagrammatically indicate the desired location and arrangement of conduit runs, equipment, and other items.

2. Exact locations shall be determined by the CONTRACTOR in the field, based on the physical size and arrangement of equipment, finished elevations, and other obstructions.

3. Follow the locations on the Drawings, however, as closely as possible.

4. Conduits

a. Where conduit development drawings or "home runs" are indicated, route the conduits in accordance with those requirements.

b. Provide exposed or encased routings as indicated.

5. Placement

a. Install conduit and equipment in such a manner as to avoid obstructions, to preserve headroom, and to keep openings and passageways clear.

b. Where exact locations are not indicated, such locations will be determined by the ENGINEER.

c. If equipment is installed without instruction and must be moved, the cost of moving shall be included as part of the WORK.

6. Workmanship

a. Install materials and equipment in strict accordance with the printed recommendations of the manufacturer, and using workers skilled in the WORK.

b. Coordinate installation in the field with other trades in order to avoid interferences.

7. Protection of Equipment and Materials

   a. Fully protect materials and equipment against damage from any cause.

   b. Cover materials and equipment, both in storage and during construction, in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint.

   c. Keep moving parts clean and dry.

   d. Replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections, as part of the WORK.

3.2 CORE DRILLING

A. Perform core drilling as required for the installation of raceways through concrete walls and floors.

B. Base the locations of floor penetrations, as may be required, on field conditions.

C. Verify exact core drilling locations based on equipment actually furnished as well as exact field placement.

D. To the extent possible, identify the existence and locations of encased raceways and other piping in existing walls and floors with the OWNER prior to any core drilling activities.

E. Repair damage to encased conduits, wiring, and piping as part of the WORK.

3.3 CONCRETE HOUSEKEEPING PADS

A. Provide concrete housekeeping pads for indoor floor-standing electrical equipment.

B. Extend housekeeping pads for equipment, including future units, 3-1/2 inches above the surrounding finished floor or grade, and 2 inches larger in both dimensions than the equipment, unless otherwise indicated.

3.4 EQUIPMENT ANCHORING

A. Floor-supported, wall, or ceiling-hung equipment and raceways shall be anchored in place by methods that will meet seismic requirements in the area where the Project is located. Refer to Section 01 33 17 – Structural Design, Support and Anchorage for support and anchorage requirements.

B. If the supported equipment is a panel or cabinet enclosed within removable side plates, match supported equipment in physical appearance and dimensions.

C. Provide leveling channels anchored to the concrete pad for MCC’s, switchgear and other electrical equipment mounted on housekeeping pads.

D. Manufacturer's Recommendations

   1. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the WORK of this Contract.

   2. Submit such recommendations as Shop Drawings as indicated.

3.5 EQUIPMENT IDENTIFICATION

A. Provide nameplates for VFD's, panelboards, control and instrumentation panels, and starters, switches.

B. In addition to nameplates, equip control devices with standard collar-type legend plates.

C. Identify control devices within enclosures as indicated and similar to the subparagraph above.

D. Use equipment names and tag numbers, where indicated, on nameplates.

E. Provide typewritten circuit directories for panelboards, that accurately reflect the loads connected to each circuit.

F. Terminal Blocks

1. Label termination points on terminal blocks by identifiers on the blocks.

2. Provide identifiers that have been preprinted by the terminal manufacturer or custom-printed.

3. Hand-lettered markers will not be accepted.

G. Provide arc-flash labels for all distribution equipment, stand-alone disconnects, starters, and VFDs. Fill in all values as required by NFPA 70E, and as calculated as part of the 26 05 73 - Protective Device Studies. Verify that all settings as prescribed by the approved Protective Device Study have been implemented in the field.

3.6 CLEANING

A. Before final acceptance, thoroughly clean the electrical WORK of cement, plaster, and other materials.

B. Remove temporary tags, markings, stickers, and the like.

C. Remove oil and grease spots with a non-flammable cleaning solvent by carefully wiping and scraping cracks and corners.

D. Apply touch-up paint to scratches on panels and cabinets.

E. Vacuum clean electrical cabinets and enclosures. Do not use compressed air to clean cabinets.

F. Properly dispose cleaning debris and refuse off-site.

END OF SECTION

SECTION 26 01 26 – ELECTRICAL TESTS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. This Section specifies the WORK necessary to test, commission, and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.

B. The WORK of this Section includes furnishing the labor, equipment, and power required to support the testing indicated in other Divisions of these Specifications. Electrical testing indicated herein and functional testing of power and controls not tested under other Divisions. This scope may require the CONTRACTOR to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers, etc.

C. The requirements of Section 26 00 00 - Electrical Work, General, apply to the WORK of this Section.

D. Carry out tests indicated herein for individual items of materials and equipment in other Sections. Testing shall be done in accordance with the manufacturer's instructions, these Specifications, and applicable NETA Acceptance Testing Specifications, NEMA, ANSI, NFPA, and ASTM Standards.

1.2 REFERENCES

A. General

1. The publications listed below form a part of this specification to the extent referenced.

2. Where a date is given for reference standards, the edition of that date shall be used. Where no date is given for reference standards, the latest edition available on the date of the Notice Inviting Bids shall be used.

B. American National Standards Institute (ANSI)

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE)

D. IEEE 400-2001, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems

E. IEEE 576-2000, Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications

F. InterNational Electrical Testing Association (NETA)

G. NFPA 70, National Electrical Code (NEC)

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Contractor Submittals.

1. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested

deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Submit complete system test procedures for review. Test procedures shall include but not be limited to:

1. Detailed procedures in sufficient detail to verify conformance with these Specifications.

2. Incorporation of the Test Record Sheets included at the end of this Section. These Test Record Sheets are not specifically called out elsewhere in this Section but are a requirement for all applicable items.

3. Detailed comprehensive testing schedule including:

a. Each major piece of electrical distribution equipment.

b. Each major electrical subsystem.

c. Duration of each test.

d. Milestone test completion date.

e. Ambient Conditions at time of test

f. Date of test results submittals following completion of the tests.

g. Names and qualifications of the individual(s) responsible for performing the testing.

C. Following completion of the test submit the completed test results to the Engineer for review. The results shall include a dedicated section with the “as-left” settings of all devices, relays, circuit breakers, etc.

D. Test result shall be submitted in one submittal

E. Test reports shall be based on NETA’s latest Acceptance Testing Specifications having a sign-off, pass/fail data filed for each line item covered by NETA’s Acceptance Testing Specifications latest edition.

1.4 COMMISSIONING

A. The several day test in Section 01 75 00 shall not be attempted until all subsystems have been found to operate satisfactorily. Commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer

command, as applicable. Simulation of process parameters shall be considered only upon receipt of a written request by the CONTRACTOR.

B. Motor Current Tabulation

1. Electrical power meters shall be recorded every half-hour during the commissioning.

2. Motors which have current/power measurement capabilities shall have this data recorded every 30 minutes while operating during commissioning.

3. Power monitored amperes, voltage, and kilowatts for each phase shall be recorded every 30 minutes during commissioning.

PART 2 -- TESTING & REPORTS

2.1 PRE-ENERGIZATION AND OPERATING TESTS

A. The complete electrical installation shall be performance tested when first installed on-site. Each protective, switching, and control circuit shall be adjusted in accordance with the recommendations of the protective device study and tested by actual operation using current injection or equivalent methods as necessary to ensure that each and every such circuit operates correctly to the satisfaction of the authority having jurisdiction.

1. Instrument Transformers. All instrument transformers shall be tested to verify correct polarity and burden.

2. Protective Relays. Each protective relay shall be demonstrated to operate by injecting current or voltage, or both, at the associated instrument transformer output terminal and observing that the associated switching and signaling functions occur correctly and in proper time and sequence to accomplish the protective function intended.

3. Switching Circuits. Each switching circuit shall be observed to operate the associated equipment being switched.

4. Control and Signal Circuits. Each control or signal circuit shall be observed to perform its proper control function or produce a correct signal output.

5. Acceptance Tests. Complete acceptance tests shall be performed, after the station installation is completed, on all assemblies, equipment, conductors, and control and protective systems, as applicable, to verify the integrity of all the systems.

B. Test Report. A test report covering the results of the tests required in the Pre-Energization and Operating Tests shall be delivered to the authority having jurisdiction prior to energization. Acceptance Testing shall be in accordance with NETA ATS-2017, *For Electrical Power Equipment and Systems*, published by the InterNational Electrical Testing Association.

2.2 TEST REQUIREMENTS

A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.

1. Power Instrumentation: Demonstrate that voltmeter and ammeter switches are functional. Demonstrate that kilowatt meters are within catalog accuracy as installed.

2. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.

3. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known and reasonable current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.

4. Low Voltage Cables-600 volts Maximum

    a. Visual and Mechanical Inspection

        1) Compare cable data with drawings and specifications.

        2) Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.

        3) Inspect bolted electrical connections for high resistance using one of the following methods:

            a) Use of low-resistance ohmmeter

            b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS- 2017, Table 100.12.

            c) Perform thermographic survey in accordance with below Section Thermographic Survey.

        4) Inspect compression-applied connectors for correct cable match and indentation.

        5) Inspect for correct identification and arrangements.

        6) Inspect cable jacket insulation and condition.

    b. Electrical Tests

        1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be one minute.

            a) Motor feeders tested with motors disconnected and controller open.

            b) Motor control circuits tested and verified for proper operation with control stations and overcurrent devices connected.

            c) Panelboard feeders tested with feeder breaker open and panel-board connected. If a lighting transformer is associated with the panelboard, it shall be connected and the test made for both primary and secondary sides.

            d) Conductors of main lighting feeders, including lighting panel with branch circuits open.

e) Prior to performing insulation resistance tests on cables, verify that they are not connected to a solid state device.

f) Equipment which may be damaged during this test shall be disconnected.

g) The Engineer shall be consulted if minimum insulation values cannot be obtained.

2) Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.

3) Perform continuity test to insure correct cable connection.

c. Test Values – Visual and Mechanical

1) Compare bolted connection resistance to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Bolt-torque levels should be in accordance with NETA ATS-2017, Table 100.12 unless otherwise specified by the manufacturer.

3) Results of the thermographic survey shall be in accordance with the below Section Thermographic Survey.

d. Test Values – Electrical

1) Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS-2017 Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.

3) Cable shall exhibit continuity.

4) Deviations in resistance between parallel conductors shall be investigated.

5. A functional test and check of electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:

a. Visual and physical check of cables, circuit breakers, transformers, and connections associated with each item of new and modified equipment.

b. Verification that electrical equipment has been labeled with Arc Flash protection boundary and PPE levels, as required by Section 26 05 73 – Protective Device Studies.

c. Setting of protective relays in conformance with results of the Short Circuit Study required by Section 26 05 73 - Protective Device Studies and testing of relays to assure that relays will trip at the current value and time required by the Study.

d. Circuit Breakers

1) Circuit breakers that have adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field-adjusted by a representative of the circuit breaker manufacturer.

2) Time and pickup setting shall correspond to the recommendations of the Short Circuit Study.

3) Setting shall be tabulated and proven for each circuit breaker in its installed position.

4) Test results shall be certified by the person performing the tests and shall be submitted to the ENGINEER.

B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the ENGINEER and after process control devices have been adjusted as accurately as possible. Alarm conditions shall be simulated for each alarm point, and alarm indicators shall be checked for proper operation. It is intended that the CONTRACTOR will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.

C. Metering and indication lights for motors and other devices shall be tested for proper operation.

D. All control circuits such as motor, interlock and remote shall be tested for proper operation.

E. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.

F. THERMOGRAPHIC SURVEY

1. Visual and Mechanical Inspection

a. Inspect physical, electrical, and mechanical condition.

b. Remove all necessary covers prior to thermographic inspection. Utilize appropriate caution, safety devices, and personal protective equipment.

2. Equipment to be inspected shall include all 120 volt and higher current-carrying devices including as part of the Work. Testing of field instrumentation, SCADA & PLC’s are not required.

3. Provide report including the following:

a. Description of equipment to be tested.

b. Discrepancies.

c. Temperature difference between the area of concern and the reference area.

d. Probable cause of temperature difference.

e. Areas inspected. Identify inaccessible and/or unobservable areas and/or equipment.

f. Identify load conditions at time of inspection.

g. Provide photographs and/or thermograms of the deficient area.

h. Recommended action.

4. Test Parameters

a. Inspect distribution systems with imaging equipment capable of detecting a minimum temperature difference of 1°C at 30°C.

b. Equipment shall detect emitted radiation and convert detected radiation to visual signal.

c. Thermographic surveys should be performed during periods of maximum possible loading but not less than 40 percent of rated load of the electrical equipment being inspected. Refer to ANSI/NFPA 70B-2010, Section 11-17 (Infrared Inspection).

5. Test Values

a. Suggested actions based on temperature rise can be found in Table 100.18.

6. RE-INSPECTION

a. All items that are reported deficient in the thermography reports section of the inspection report shall be re-inspected after repairs have been made.

b. Original specification will apply to re-inspections.

c. Submit re-inspection reports and indicate that repairs have fixed the anomaly or indicate any remaining anomalies.

2.3 TEST REPORTS

A. The test report shall include the following:

1. Summary of project.

2. Description of equipment tested.

3. Description of test.

4. Test data.

5. Analysis and recommendations.

B. Test data records shall include the following minimum requirements:

1. Identification of the testing organization.

2. Equipment identification.

3. Humidity, temperature, and other atmospheric conditions that may affect the results of the tests/calibrations.

4. Date of inspections, tests, maintenance, and/or calibrations.

5. Identification of the testing technician.

6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.

7. Indication of expected results when calibrations are to be performed.

8. Indication of “as-found” and “as-left” results.

9. Sufficient spaces to allow all results and comments to be indicated.

C. The testing firm shall furnish a copy or copies of the complete report to the owner as required in the acceptance contract.

TABLE 100.18

THERMOGRAPHIC SURVEY
SUGGESTED ACTIONS BASED ON TEMPERATURE RISE

Temperature difference (ΔT) based on comparisons between similar components under similar loading.	Temperature difference (ΔT) based upon comparisons between component and ambient air temperatures.	Recommended Action
1ºC - 3ºC	1ºC - 10ºC	Possible deficiency; warrants investigation
4ºC - 15ºC	11ºC - 20ºC	Indicates probable deficiency; repair as time permits
- - - - - -	21ºC - 40ºC	Monitor until corrective measures can be accomplished
>15ºC	>40ºC	Major discrepancy; repair immediately

Temperature specifications vary depending on the exact type of equipment. Even in the same class of equipment (i.e., cables) there are various temperature ratings. Heating is generally related to the square of the current; therefore, the load current will have a major impact on ΔT. In the absence of consensus standards for ΔT, the values in this table will provide reasonable guidelines.

An alternative method of evaluation is the standards-based temperature rating system as discussed in Chapter 8.9.2, Conducting an IR Thermographic Inspection, *Electrical Power Systems Maintenance and Testing*, by Paul Gill, PE, 1998.

It is a necessary and valid requirement that the person performing the electrical inspection be thoroughly trained and experienced concerning the apparatus and systems being evaluated as well as knowledgeable of thermographic methodology

PART 3 -- TEST RECORD SHEETS

The test record sheets listed below shall be used to record testing of electrical equipment and of the electrical installation as required by these specifications. Sample copies of each sheet are attached.

Sheet No.	Title
1	Insulation Resistance (Power Cable) Test Record
2	Bonding Resistance Readings (Electrical Equipment) Test Record
3	Record Feeder Breaker (480 V MCC) Test Record
4	Breaker/Contactor (480 V MCC) Test Record
5	460 V Motor Circuit (480 V MCC) Test Record
6	Electric Motor Run-In Test Record
7	Thermographic Test Record

INSULATION RESISTANCE
(POWER CABLE)
TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

TEST EQUIPMENT: _____ TEST VOLTAGE: _____

AMBIENT TEMPERATURE: ___ ºC _____ ºF DATE: _____

NOTES: 1. Perform Insulation Resistance Test (megger) between each conductor and all other conductors and metallic sheath for cables with nonshielded conductors. Test between each conductor and shield for multiconductor cables with shielded conductors. Record lowest reading for each cable.

2. Use 1,000-V test set for cable rated 600 volts and 2,500-V test set for cable rated over 600 volts.

3. Readings will vary inversely with temperature and cable length. When the use of temperature correction factors is specified, attach a second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

Panel No. Circuit No. Feeder No.	Wire Tagging	Cable Rated Voltage	Wire or Cable Quantity	Insulation Size	From	To	Resistance (megohms)*	Initials

*Minimum acceptable values:

Cable Rated Voltage	Test Duration	Resistance for Cable Only	Cable/Wire Size or Amperage (megohms)	Resistance When Cable Connected to Equipment (ohms)

DISTRIBUTION:

BONDING RESISTANCE READINGS
(ELECTRICAL EQUIPMENT)
TEST RECORD

TEST EQUIPMENT USED: _____ WEATHER: _____

NOTES: 1. Electrical equipment bonded to the main grounding system or dedicated ground rod, as indicated on drawings listed below.

2. Measure resistance from ground wire tap to tagged equipment bus bars, tagged equipment enclosures, and any other points indicated on the drawings.

EQUIPMENT TAG NO. OR STRUCTURE	DRAWING	MEASURED RESISTANCE (ohms)	INITIALS/DATE

DISTRIBUTION:

CONTRACTOR/Date _____

FEEDER BREAKER (480 V MCC)
TEST RECORD

EQUIPMENT DESIGNATION		
LOAD (kW/kVA)	VOLTAGE	F.L.A.
CIRCUIT BREAKER MFG.	RATING	SETTING
CONDUCTOR SIZE POWER	GROUND	

1. Check nameplate data of breaker against approved vendor drawings. _____
2. Check breaker components for cleanliness. _____
3. Check mechanical function of breaker. _____
4. Check wiring for proper identification. _____
5. Check conduits/cables for tagging. _____
6. Check components for identification. _____
7. Check equipment for conformance of area classification. _____
8. Check installation for seals, breathers, and drains. _____
9. Verify power conductor continuity. _____
10. Check that power cable insulation resistance test (megger) is completed. _____

DISTRIBUTION:

CONTRACTOR/Date _____

BREAKER/CONTACTOR (480 V MCC)
TEST RECORD

EQUIPMENT DESIGNATION			
LOAD (kW/kVA)		VOLTAGE	F.L.A.
CIRCUIT BREAKER MFG.		RATING	SETTING
CONTACTOR MFG.		SIZE	
CONDUCTOR SIZE	POWER	CONTROL	GROUND

1. Check nameplate data of breaker, contactor fuses and relays against approved vendor drawings. _____
2. Check main and auxiliary contacts. _____
3. Check contactor/breaker components for cleanliness. _____
4. Check control fuses, CPT rating, and coil voltage. _____
5. Check mechanical function of contactor and breaker. _____
6. Check wiring for proper identification. _____
7. Check conduits/cables for tagging. _____
8. Check components for identification. _____
9. Check equipment for conformance to area classification. _____
10. Check installation for seals, breathers, and drains. _____
11. Verify continuity of all power and control leads. _____
12. Check that power and control cable Insulation Resistance Test (megger) is completed. _____
13. Complete functional operation check of the control circuit using contract drawings and approved vendor drawings. Close and open the contactor using all control devices. _____

DISTRIBUTION:

CONTRACTOR/Date _____

460 V MOTOR CIRCUIT (480 V MCC)
TEST RECORD

EQUIPMENT DESIGNATION			
MOTOR TAG NO.		VOLTAGE	F.L.A.
KW/HP		RPM	S.F.
CIRCUIT BREAKER MFG.		RATING	SETTING
STARTER MFG.		SIZE	O/L HTR. SIZE
C.T. RATIO		O/L RELAY SETTING	
CONDUCTOR SIZE	POWER	GROUND	

1. Check motor starter for cleanliness. _____

2. Check nameplate data and tagging of motor starter components for conformance to approved vendor drawings. _____

3. Check conduits and/or cables for correct tagging. _____

4. Check equipment and installation for conformance to area classification. _____

5. Check main and auxiliary contacts of breaker and contactors. _____

6. Manually check mechanical operation of breaker, contactor, O/L relay, and O/L reset device. _____

7. Check continuity of power and control cables. _____

8. Complete functional operation check of the motor control circuit using the contract drawings and approved vendor drawings. Close and open the starter using all control devices. _____

9. Verify proper operation of motor winding space heater unit. _____

DISTRIBUTION:

CONTRACTOR/Date _____

ELECTRIC MOTOR RUN-IN
TEST RECORD

TEST EQUIPMENT: _____ REFERENCE DRAWING: _____

NOTES: 1. Duration of tests to comply with specifications.

TEST	REMARKS	INITIALS/DATE
RESISTANCE: Bonding resistance measured from motor frame to main ground/earth system tap. _____ ohms		
VOLTAGE: Actual voltage measured at Motor Control Center. _____ volts		
ROTATION CHECK: Bump motor to verify rotation. Motor to be uncoupled.		
NO LOAD CURRENT: At beginning of test _____ amps At end of test _____ amps		
TEMPERATURE OF BEARING: Check bearing for high temperature: Before start: 15 minutes after start 30 minutes after start 1 hour after start 2 hours after start 3 hours after start		
VIBRATION: Make visual inspection during run-test. Record any unusual vibration in remarks column.		
NOISE: Record any unusual noise in remarks column.		

DISTRIBUTION:

CONTRACTOR/Date _____

THERMOGRAPHIC INSPECTION
TEST RECORD

EQUIPMENT: _____

THERMAL AND ELECTRICAL INFORMATION

THERMAL DATA (°F/°C) AND RISE				MANUAL READINGS			
A Phase	____/____	Reference	_____°F	A Phase	_____ A	A/ B Volts	_____V
B Phase	____/____	Temperature	_____° C	B Phase	_____ A	B/C Volts	_____V
C Phase	____/____	ΔT	_____°F	C Phase	_____ A	A/C Volts	_____V
Neutral	____/____	or Rise	_____° C	Neutral	_____ A	A/N Volts	_____V
ANOMALY TEMP(°F/°C)							
PROBLEM DESCRIPTION:							
RECOMMENDATION:							

ANOMALY PRIORITY

CRITICAL - IMMEDIATE ATTENTION SUGGESTED

SEVERE - PROBABLE FAILURE, PROMPT ACTION RECOMMENDED

INTERMEDIATE - MONITOR PROBLEM, SCHEDULE MAINTENANCE

MINOR - SCHEDULE ROUTINE MAINTENANCE AT NEXT OPPORTUNITY

DISTRIBUTION:

CONTRACTOR/Date _____

END OF SECTION

SECTION 26 05 10 - ELECTRIC MOTORS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General: The CONTRACTOR shall provide electric motors, accessories, and appurtenances complete and operable, in conformance to the Contract Documents.

B. The provisions of this Section apply to low voltage 3 phase, AC squirrel cage induction motors throughout the Contract Documents, except as indicated otherwise.

C. The CONTRACTOR shall assign to the equipment supplier the responsibility to select suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review by the ENGINEER. Such review will consider future availability of replacement parts and compatibility with driven equipment

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

1. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Complete motor data shall be submitted with the driven machinery Shop Drawings. Motor data shall include:

1. Machine name and specification number of driven machine

2. Motor manufacturer

3. Motor type or model and dimension drawing. Include motor weight.

4. Nominal horsepower

5. NEMA design

6. Enclosure

7. Frame size

8. Winding insulation class and temperature rise class

9. Voltage, phase, and frequency ratings

10. Service factor

11. Full load current at rated horsepower for application voltage

12. Full load speed

13. Guaranteed minimum full load efficiency. Also nominal efficiencies at 1/2 and 3/4 load.

14. Type of thermal protection or overtemperature protection, where included

15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable

16. Bearing data. Include recommendation for lubricants of relubricatable type bearings.

17. If utilized with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery. Provide shaft grounding details and information. Provide insulated bearing details and information.

18. Power factor at 1/2, 3/4 and full load.

19. Recommended size for power factor correction capacitors to improve power factor to 0.95 percent lagging when operated at full load.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Electric motors driving identical machines shall be identical.

B. Maximum motor loading shall be equal to nameplate horsepower rating or less, exclusive of service factor and be verifiable from the submittal data of the driven machinery.

C. Motor Capacity

1. The CONTRACTOR shall size motors for the larger of the following criteria:

a. Size motors to continuously carry the maximum load that develops across the full range of driven equipment operation.

b. Size motors for minimum size indicated

2. In every case, motor size shall be derated from nameplate values as follows:

a. Ambient Temperature

1) For ambient temperatures up to but not exceeding 40 degrees C, no derating is required.

2) For ambient temperatures exceeding 40 degrees but less than 50 degrees C, derate nameplate HP ratings to 85 percent.

b. Site Altitude: No derating is required for altitudes less than 3300 feet (1000 meters). Higher altitudes require the following derating factors:

Altitude	Derating Factor
3,300 to 5,000 ft	97 percent
5,001 to 6,600 ft	94 percent
6,601 to 8,300 ft	91 percent
8,301 to 9,900 ft	88 percent
9,901 to 11,500 ft	85 percent

3. Increased circuit breaker, magnetic starter, and conductor and conduit capacities required for motors larger than the indicated sizes shall be provided as part of the WORK.

D. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial use apparatus may be excepted from these requirements to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 DESIGN REQUIREMENTS

A. General: Electric motors shall comply with NEMA MG-1 - Motor and Generator. Motors used with adjustable frequency drives shall comply with NEMA MG-1, Part 31, and shall be clearly identified as “Inverter Duty.”

B. NEMA Design: Electric motors shall be NEMA Design B unless otherwise indicated. In no case shall starting torque or breakdown torque be less than the value in NEMA MG 1. Motors shall be suitable for the indicated starting method.

C. Motor Voltage Ratings: Low voltage motors shall have voltage ratings in accordance with the following, unless otherwise indicated:

1. Motors below 1/2 HP shall be rated 115 volts, single phase, 60 Hz. Dual voltage motors rated 115/230 volts, 115/208 volts, or 120-240 volts are acceptable, provided leads are brought out to the conduit box.

2. Motors 1/2 HP and larger shall be rated 460 volts, 3 phase, 60 Hz. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable, provided every lead is brought out to the conduit box.

D. Insulation: Three phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in NEMA MG 1-12.44. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dT as defined in NEMA MG 1-31. The adjustable frequency drive manufacturer shall coordinate with the motor manufacturer to determine when additional dV/dT protection is required. Where required, it shall be furnished and installed as per the manufacturer’s written instructions.

E. Motors located in non-hazardous areas shall be totally enclosed, fan cooled (TEFC) with a Service Factor of 1.15 unless otherwise indicated.

F. Motors for use in hazardous locations shall have enclosures suitable for the classification indicated. Such motors shall be U.L. listed and be stamped as such.

G. NEMA Premium Efficiency Motors

1. Motors with a nameplate rating of 1 HP and larger shall be NEMA premium efficient units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112 - Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.

2.3 ACCESSORY REQUIREMENTS

A. General: Horizontal motors 3 HP and larger and every vertical motor shall have split-type cast metal conduit boxes. Motors shall be provided with oversized conduit boxes. Where conduit sizes indicated do not match the motor terminal box, the CONTRACTOR shall provide means to accommodate the motor requirements. Motor boxes other than open drip-proof shall be gasketed.

B. Lifting Devices: Motors weighing 265 lb (120 Kg) or more shall have suitable lifting eyes for installation and removal.

C. Special Requirements: The CONTRACTOR shall refer to individual equipment specifications for special requirements such as motor winding thermal protection or multi-speed windings.

D. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated.

E. Nameplate: Motors shall be fitted with permanent stainless steel nameplates indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40. Inverter duty motors shall be clearly identified as such.

F. Inverter duty motors shall be provided with shaft grounding rings. Rings shall be factory installed, and shall be manufactured by **Aegis**, or equal. The motor warranty shall include coverage against VFD-induced bearing damage or failure.

2.4 MOTOR THERMAL PROTECTION

A. Single Phase Motors: Single phase 120, 208, or 230 volt motors shall have integral thermal overload protection or shall be inherently current limited.

B. Thermostats: Where indicated or specified, winding thermostats shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer. All inverter duty motors shall be provided with winding thermostats. All explosion-proof motors shall be provided with winding thermostats.

2.5 MOTOR BEARINGS

A. General: Bearing selection shall be coordinated with the requirements of the driven equipment.

B. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.

C. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with lubricated-for-life ball bearings.

D. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

E. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

F. Water cooled bearings shall not be permitted.

G. Inverter Duty Motors: Provide an insulated bearing to prevent circulating bearing currents.

2.6 MANUFACTURERS, OR EQUAL

A. **U.S. Motors/Nidec**

B. **Baldor**

C. **WEG**

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment. Shaft grounding devices shall be connected to the grounding system in accordance with the manufacturer’s recommendations.

B. Related electrical WORK involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 26.

3.2 FACTORY TESTING

A. Motors rated 100 HP and larger shall be factory tested in conformance with IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Except where specific testing or witnessed shop tests are required by the specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the ENGINEER.

3.3 FIELD TESTING

A. The CONTRACTOR shall perform the following field tests (see also Section 26 01 26 – Electrical Tests):

1. Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation.

2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage. Verify shaft grounding devices are properly grounded.

3. Check winding and bearing temperature detectors and space heaters for functional operation.

4. Test for proper rotation prior to connection to the driven equipment.

5. Visually check that motor overload heaters are properly sized and that MCP breaker settings are correct for the motor installed.

6. Test insulation (megger test) of new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION

SECTION 26 05 19 - WIRE AND CABLING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide wire and cable, complete and operable, in accordance with the Contract Documents.

B. In the event that motors provided are larger horsepower than the motors indicated, raceways, conductors, starters, overload elements, and branch circuit protectors shall be revised as necessary to control and protect the increased motor horsepower in accordance with Section 26 05 10 – Electric Motors. Revisions are part of the WORK of this Section.

1.2 ACTION SUBMITTALS

A. The CONTRACTOR shall submit Shop Drawings in accordance with Sections 01 33 00 – Contractor Submittals and 26 00 00 – Electrical Work, General.

1. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Submit cable test results in accordance with this Section as well as Section 26 01 26 – Electrical Tests.

1.3 DELIVERY, STORAGE AND HANDLING

A. The CONTRACTOR shall protect all cables from damage at all times.

B. Cable ends shall be protected from water entry in accordance with the manufacturer’s recommended procedures. Cable ends shall not be left open in manholes or other locations subject to submergence. If the cable ends become submerged prior to splicing or termination, the cables shall be replaced in their entirety.

C. Cables shall be pulled into raceways in accordance with the manufacturer’s requirements. Under no circumstances shall cable pulling tensions exceed the manufacturer’s written instructions.

D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

A. Conductors, include grounding conductors, shall be stranded copper. Aluminum conductor and/or solid conductor wire and cable will not be permitted. Insulation shall bear the UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. Conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.

B. Low Voltage Power and Lighting Wire

1. Wire rated for 600 volts in duct or conduit for power and lighting circuits shall be single conductor, Class B Type XHHW or XHHW-2 cross-linked polyethylene conforming to UL-44 - UL Standard for Thermoset-Insulated Wires and Cables. THHN/THWN wire shall not be permitted to be used for any field routed power or control wiring in this project.

2. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

3. Conductors for branch circuits as defined in Article 100 of the NEC shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

4. Wiring for 600 volt class power and lighting shall be as manufactured by **Okonite**, **General Cable**, **Southwire**, or equal.

C. Low Voltage Control Wire

1. Low voltage control wire in duct or conduit shall be the same type as power and lighting wire indicated above.

2. Control wiring shall be No.14 AWG.

3. Control wires inside panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations, and be as manufactured by **American, General Cable,** or equal.

D. Instrumentation Cable

1. Instrumentation cable shall be rated at 300 volts, minimum.

2. Individual conductors shall be No. 16 AWG stranded, tinned copper. Insulation shall be color coded polyethylene: black-clear for 2 conductor cable and black-red-clear for 3 conductor cable.

3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester foil shield, a No. 18 or larger AWG stranded, tinned copper drain wire, and a PVC outer jacket with a thickness of 0.047-inches.

4. Single pair, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 8719,** similar by **General Cable,** or equal.

5. Single triad, No. 16 AWG, twisted, shielded cable shall be **Belden Part No. 8618,** similar by **General Cable,** or equal.

E. Industrial Ethernet Cable

1. Industrial Ethernet cables shall be No. 23 AWG with four pairs of solid bare copper conductors rated at 300 volts. Individual pairs shall be twisted. Cable shall be UL certified for as CAT 6 cable. Cable shall be Belden or equal.

   a. Conductor Insulation : Polyolefin for individual conductors. Overall cable shall have industrial grade PVC outer jacket. Outer jacket shall be oil and sunlight resistant.

   b. Installation Temperature Range of -25°C to +75°C. Operating Temperature Range of -40°C to +75°C.

   c. Electrical Compliance: NEC (UL) CMR cable. Cable shall be UL1666 vertical riser-rated.

   d. Performance: cable shall be third-party verified to be TIA-568.2-D Category 6.

   e. Terminate with industrial grade RJ45 Ethernet cable connectors.

F. VFD Power Cable

1. VFD power cable shall be three (3) conductor, stranded copper, PVC jacketed, shielded type, tray cable (TC) rated 600 volts with three (3) symmetrical ground conductors. The individual conductors shall be UL listed as Type XHHW-2 or RWH-2 rated for 90 degrees C at wet and dry locations, with XLPE insulation.

2. VFD Cables shall be as manufactured by **Belden, Alpha**, **General Cable,** or equal.

G. Cable Splices and Terminations

1. Where cable lugs are required for power cable terminations, utilize compression lugs – **3M** Scotchlok 30000 and 31100 Series, **Penn Union** HBBLU and BLU, **Burndy** Hylug, or equal. Utilize compression tools as recommended by the manufacturer. Pressure type, twist-on connectors (wire nuts) will not be acceptable.

2. Pre-insulated fork tongue lugs shall be **Thomas & Betts, Burndy**, or equal.

3. General purpose insulating tape shall be **Scotch No. 33**, **Plymouth Slip-knot**, or equal. High temperature tape shall be polyvinyl as manufactured by **Plymouth, 3M,** or equal.

4. Labels for coding 600 volt wiring shall be computer printable or pre-printed, self-laminating, self-sticking, as manufactured by **W.H. Brady, 3M**, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. The CONTRACTOR shall provide, terminate and test all power, control, and instrumentation conductors.

B. The CONTRACTOR shall, as a minimum, provide the number of control wires listed in the conduit schedule or on the Contract Drawings. Excess wires shall be treated as spares for future use.

C. Conductors shall not be pulled into any raceway until raceway has been cleared of moisture and debris.

D. Pulling tensions on raceway cables shall be within limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

E. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.

F. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be neatly fanned out to terminals.

G. Single conductor cable in cable trays shall be No. 1/0 or larger and shall be of a type listed and marked for use in cable trays. Tray cable smaller than 1/0 shall be multi-conductor, with outer jacket.

3.2 FIELD ASSEMBLY

A. General

1. Wire taps and splices shall be properly taped and insulated according to their respective classes.

2. Stranded conductors shall be terminated directly on equipment box lugs making sure that conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

3. Excess control and instrumentation wires shall be long enough to terminate at any terminal block in the enclosure, be properly taped, be identified with origin, and be neatly coiled.

B. Control Wire and Cable

1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.

2. In motor control centers, and control panels, control wire and spare wire shall be terminated to terminal strips.

3. The CONTRACTOR shall provide as a minimum the number of control wires listed in the conduit schedule or as indicated in the Contract Documents. Excess wires shall be treated as spares.

C. Instrumentation Wire and Cable

1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4 - 20 mA system.

2. Two and 3 conductor shielded cables installed in conduit runs which exceed available standard cable lengths may be spliced in pullboxes with the prior approval of the ENGINEER. Such cable runs shall have only one splice per conductor.

D. Power Wire and Cable

1. 120/208-volt, 120/240-volt, and 480/277-volt branch circuit conductors may be spliced in suitable fittings at locations determined by the CONTRACTOR.

2. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of 2 layers of varnished cambric tape overtaped with a minimum of 2 layers of high temperature tape.

3. VFD shielded power cables shall have the shield grounded at all locations where it is exposed.

E. Cable Identification

1. General: Wire and cable shall be identified for proper control of circuits and equipment and to reduce maintenance effort. Identification shall be installed at every termination point. Conductor identification devices shall be per 26 00 00 – Electrical Work, General.

2. Identification Numbers: The CONTRACTOR shall assign to each power, control and instrumentation wire and cable a unique identification number. Numbers shall be assigned to conductors having common terminals and shall be shown on "as built" drawings. Identification numbers shall appear within 3-inches of conductor terminals, and shall be identified at each terminal. "Control and Instrumentation Conductors" shall be defined as any conductor used for control, interlock, alarm, annunciator, or signal purposes.

a. Conductors shall be identified with numbers at both ends. Conductor tag numbers shall consist of the equipment number followed by a dash followed by the conductor number specified on the control diagram. Wherever possible, the conductor number shall be the same as the equipment terminal to which it connects. Example:

1) Equipment Tag number = P110-1122 - L1 where:

2) P110-1122 = cable number

3) L1 = conductor number

b. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. Individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers assigned in the Contract Documents.

c. 120/208-volt system feeder cables and branch circuit conductors shall be color coded as follows: Phase A - black, Phase B - red, Phase C - blue, and Neutral - white. The 480/277-volt system conductors shall be color coded as follows:

Phase A - Brown, Phase B - Orange, Phase C - Yellow, and Neutral - Gray. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the Site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs. Color coding tape shall be used where colored insulation is not available where permitted by NEC. Colored identification tape may be used on conductors between the local disconnect and the load, where permitted by the NEC. Any phase changes necessary for proper rotation shall be made at the driven equipment where colored insulation is used. Phase changes may be made on the load side of the local disconnect, where phase colors are identified using tape.

d. General purpose AC control cable shall be red. General purpose DC power cable shall be blue. General purpose DC control cable shall be violet.

e. AC foreign voltage shall be Yellow. DC foreign voltage shall be Blue/White.

f. Spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

g. Terminal strips shall be identified by computer printable, cloth, self-sticking marker strips attached under the terminal strip.

3.3 FIELD QUALITY CONTROL

A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-95-658/NEMA WC70 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted in accordance with Section 01 33 00 – Contractor Submittals, prior to shipment of cable. The following field tests (in addition to the tests specified in Section 26 01 26 – Electrical Tests) shall be the minimum requirements:

1. Power cable rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmeter.

2. Field testing shall be done after cable is installed in the raceways.

3. Field megger testing may be performed by the CONTRACTOR or a NETA-certified test organization. When tested by the CONTRACTOR, submit test equipment calibration sheets prior to performing any field testing. Test results shall be submitted to the ENGINEER for review and acceptance.

4. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. Continuity Test: Control and instrumentation cable shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing cable in service.

C. Ethernet cable shall be third-party verified to be TIA-568.2-D Category 6.

END OF SECTION

SECTION 26 05 26 – GROUNDING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide the electrical grounding system, complete and operable, as indicated in accordance with the Contract Documents.

B. The requirements of Section 26 00 00 – Electrical Work, General apply to this Section.

C. Single Manufacturer

1. Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.2 SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 –Contractor Submittals and Section 26 00 00 – Electrical Work, General.

1. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Shop Drawings

1. Submit manufacturer's product information for connectors, clamps, and all grounding system components, showing compliance with the requirements of this Section.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

A. Components of the grounding electrode system shall be manufactured in accordance with UL 467 - Standard for Safety Grounding and Bonding Equipment, and shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

B. Grounding System

1. Grounding loop conductors shall be bare annealed tin-plated copper conductors.

2. Conductors shall be No. 4/0 unless indicated otherwise.

3. Exposed Connectors

    a. Exposed grounding connectors shall be of the compression type (connector-to-cable), constructed of high-copper alloy, and manufactured specifically for the particular grounding application.

    b. The connectors shall be **Burndy, O.Z. Gedney**, or equal.

4. Equipment Grounding Circuit Conductors

    a. The conductors shall be the same type and insulation as the load circuit conductors.

    b. The minimum size shall be as indicated. Where not indicated, sizes shall conform to Table 250.122 of the National Electrical Code.

    c. Metallic conduit systems shall have an equipment grounding wires as well as being equipment grounding conductors themselves.

5. Grounding Materials Manufacturer, or Equal

    a. Copperweld

    b. Thermoweld

    c. Burndy

    d. Thomas and Betts

    e. OZ Gedney

PART 3 -- EXECUTION

3.1 PREPARATION

A. Provide a separate grounding conductor, securely grounded in each raceway independent of raceway material.

B. Provide a separate grounding conductor for each motor and connect at motor box. Provide a supplemental ground connection for motor shaft grounding rings, where applicable.

C. Do not use bolts for securing the motor box to the frame or the cover for grounding connectors.

D. Sizes shall be as indicated on the Conduit Schedule and in accordance with NEC Article 250.

E. Route the conductors inside the raceway.

F. Individually bond the raceway to the ground bus.

G. Provide a green insulated wire as grounding jumper from the ground screw to a box grounding screw, and, for grounding type devices, to the equipment grounding conductor.

H. Provide a separate grounding conductor in each individual raceway for parallel feeders. Connect the parallel ground conductors together at each end of the parallel run, as required by the NEC.

I. Low Voltage Grounded System (600V or less)

1. A low-voltage grounded system is defined as a system where the local power supply is a transformer, with the transformer secondary grounded.

2. Grounding system connections for a premises-wired system supplied by a grounded AC service shall be provided with a grounding electrode connector connected to the grounded service conductor at each service, in accordance with the NEC.

3. The grounded circuit conductor shall not be used for grounding non-current-carrying parts of equipment, raceways, and other enclosures except where specifically listed and permitted by the NEC.

J. Instrumentation Shield Grounding

1. Shielded instrumentation cable shall have its shield grounded at one end only unless the approved Shop Drawings indicate that the shield will be grounded at both ends.

2. The grounding point shall be at the control panel or at the receiving end of the signal carried by the cable.

3. The termination of the shield drain wire shall be on its own terminal screw.

4. Jumper together the terminal screws, using manufactured terminal block jumpers or a No. 14 green insulated conductor.

5. Connect the ground bus via a green No. 12 conductor to the main ground bus for the panel.

END OF SECTION

SECTION 26 05 33 - ELECTRICAL RACEWAY SYSTEMS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide electrical raceway systems, complete and in place, as indicated in accordance with the Contract Documents.

B. In the event that individual equipment loads provided are larger than indicated in the Contract Documents, revise raceways, conductors, starters, overload elements, and branch circuit protectors as necessary in order to control and protect the increased connected load in conformance to NEC requirements as part of the WORK.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 –Contractor Submittals, and Section 26 00 00 – Electrical Work, General.

1. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Shop Drawings

1. Submit complete catalog cuts of raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.

2. Installation drawing including individual conduit numbers, routing, termination drawings, conduit sizes, circuit numbers contained in each conduit, and number and size of wires in each conduit. CONTRACTOR shall submit these drawings to the ENGINEER for approval. The drawings shall show detailed conduit routing before installation of conduit. These drawings shall be used as the “as-built” record drawings, with all field corrections noted. The CONTRACTOR shall also detail exposed conduit routing and show the routing of pipes, HVAC ducts, etc., clearly indicating that the conduit routing will not have interference as required by the drawings specifying these layouts. These drawings are to be submitted and approved before any conduit installation is begun.

3. As-Built Drawings

a. Prepare as-built drawings of exposed raceways, junction boxes, pull boxes, and electrical and instrumentation equipment.

b. Provide “as-built” drawings per section 1.2.B.2 in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Pull and junction boxes, fittings, and other indicated enclosures that are dedicated to the raceway system shall comply with the requirements of this Section.

2.2 CONDUIT

A. Rigid Aluminum (RAL) Conduits

1. Provide rigid aluminum conduit manufactured from 6063 alloy, temper T-1.

2. Provide rigid aluminum conduit manufactured in accordance with NEMA C80.5 – Electrical Rigid Aluminum Conduit, and UL-6A – Electrical Rigid Metal Conduit - Aluminum, Red Brass and Stainless Steel.

3. Manufacturer, or Equal

a. **V.A.W. of America**

b. **Alcoa**

B. Rigid Galvanized Steel (RGS) Conduit

1. Provide rigid steel conduit manufactured from mild steel, hot-dip galvanized inside and out.

2. Provide rigid steel conduit manufactured in accordance with NEMA C80.1 – Electrical Rigid Steel Conduit, and UL-6 – Electrical Rigid Metal Conduit - Steel.

3. Manufacturer, or Equal

a. **Allied Tube & Conduit**

b. **Triangle**

c. **Wheatland Tube**

C. PVC Rigid Non-Metallic Conduit

1. Provide rigid non-metallic conduit manufactured from Schedule 40 PVC or Schedule 80 PVC, as indicated, and sunlight-resistant.

2. Provide rigid non-metallic conduit manufactured in accordance with NEMA TC-2 - Electrical Plastic Tubing and Conduit, and UL-651 - Standard for Rigid Non-metallic Conduit.

3. Manufacturer, or Equal

a. **Carlon**

b. **Cantex**

D. Rigid PVC-Coated Galvanized Steel (RPGS) Conduit

1. The conduit shall meet the requirements for RGS conduit as indicated above.

2. Bond a PVC coating to the outer surface of the galvanized conduit.

3. Ensure that the bond between the coating and the conduit surface is greater than the tensile strength of the coating.

4. Provide the inside surfaces and threads of the conduit with a 2-mil urethane coating.

5. Provide a PVC coating thickness not less than 40 mils.

6. The PVC-coated RGS shall be manufactured in accordance with the following standards:

   a. UL-6

   b. ANSI C80.1

   c. NEMA RN1 - PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

7. Manufacturer, or Equal

   a. **Robroy Industries**

   b. **O'Kote**

   c. **Thomas & Betts**

E. Liquid-Tight Flexible Conduit

1. Provide liquid-tight flexible conduit constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket.

2. Provide liquid-tight flexible conduit manufactured in accordance with the requirements of UL-360 - Steel Conduits, Liquid-Tight Flexible.

3. Manufacturer, or Equal

   a. **Anaconda, Sealtite**

   b. **Electriflex, Liquatite**

F. Electrical Metallic Tubing (EMT) or Intermediate conduit (IMC) will not be accepted.

2.3 FITTINGS AND BOXES

A. General

1. For use with metallic conduit, provide cast and malleable iron fittings of the threaded type with 5 full threads.

2. Fittings and Boxes

a. Provide fittings and boxes with neoprene gaskets and non-magnetic stainless steel screws.

b. Attach covers by means of holes tapped into the body of the fitting.

c. Covers for fittings attached by means of clips or clamps will not be accepted.

3. Provide boxes larger than standard cast or malleable types manufactured of Type 304 or Type 316 stainless steel, NEMA 4X.

4. Terminations

a. In areas other than NEMA 1 or 12 (defined in 26 00 00), terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, Appleton, or equal.

b. In NEMA 1 and/or NEMA 12 locations, provide sealed locknuts and bushings.

c. Hubs terminating aluminum conduit to stainless steel enclosures shall be copper free aluminum.

d. Hubs terminating aluminum conduit to steel enclosures shall be stainless steel.

B. Cast Aluminum Fittings and Boxes

1. Provide cast aluminum boxes and fittings with less than 0.40 percent copper content, and use with aluminum conduit.

2. Manufacturer, or Equal

a. **O.Z. Gedney**

b. **Appleton**

c. **Crouse-Hinds**

C. PVC Fittings and Boxes

1. For use with rigid non-metallic conduit, provide fittings manufactured of solvent-welded PVC.

2. Provide boxes manufactured of PVC or fiberglass reinforced polyester (FRP).

3. Manufacturer, or Equal

a. **Carlon**

b. **Crouse-Hinds**

c. **Hoffman**

4. Provide welding solvent as required for the installation of non-metallic conduit and fittings.

D. PVC-Coated RGS Fittings

1. For use with PVC-coated RGS, provide PVC-coated coated that are the products of the same manufacturer as the conduit.

2. Provide male and female threads and internal surfaces with a 2-mil urethane coating.

E. Stainless Steel Boxes

1. Provide stainless steel boxes for all outdoor locations, in all NEMA 4X locations, and where indicated.

2. Provide NEMA 4X stainless steel boxes, constructed of Type 304 stainless steel.

3. Provide stainless steel of a minimum of 14-gauge thickness, with a brushed finish.

4. Provide clamps for opening.

5. Door Hinges

a. Provide doors with full-length stainless steel piano hinges.

b. Non-hinged boxes will not be accepted.

6. Manufacturer, or Equal

a. **Hoffman**

b. **Rohn**

c. **Hammond**

PART 3 -- EXECUTION

3.1 GENERAL

A. Run wiring in raceway unless indicated otherwise.

B. Install raceways between equipment as indicated.

C. Provide raceway systems that are electrically and mechanically complete before conductors are installed.

D. Bends and Offsets

1. Provide bends and offsets that are smooth and symmetrical, and accomplished with tools designed for this purpose.

2. Provide factory elbows wherever possible.

E. Routing

1. Where raceway routings are indicated, follow those routings to the extent possible.

2. Where raceways are indicated but routing is not indicated, raceway routing shall be the CONTRACTOR's choice and provided in strict accordance with the NEC as well as customary installation practice.

3. Provide the raceway encased, exposed, concealed, or under-floor as indicated, except conceal conduit in finished areas unless specifically indicated otherwise.

4. Adjust routings in order to avoid obstructions.

F. Coordination

1. Coordinate between trades prior to installing the raceways.

2. The lack of such coordination shall not be justification for extra compensation, and any costs for removal and re-installation to resolve conflicts shall be part of the Contract Price.

G. Support rod attachment for ceiling-hung trapeze and cable tray installations shall meet the seismic requirements in the area where the Project is located.

H. Support wireways in accordance with the manufacturer's recommendations for the seismic requirements indicated in Section 26 00 00 – Electrical Work, General.

I. Install exposed raceways parallel or perpendicular to structural beams.

J. Expansion/Deflection Fittings

1. Provide wherever exposed or encased raceways cross building expansion joints.

2. Fittings shall have integral bonding jumper where encased, and external (or integral) bonding jumpers where exposed.

3. Install expansion/deflection fittings where conduit movement is expected in more than one dimension, and where conduits transition out of structures in locations where differential settlement may occur.

4. Fittings shall be water-tight and corrosion resistant.

5. Provide expansion and expansion/deflection fittings constructed of the same material as the raceway to which they are installed.

6. Where the CONTRACTOR confirms with the ENGINEER that conduit movement is only in one dimension oriented in-line with the conduit, expansion fittings may be used in lieu of expansion/deflection fittings

K. Install exposed raceways at least 1/2 inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, install exposed raceways at least 1/4 inch from the face of walls or ceilings by the use of clamp backs or struts.

L. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, provide a means of suitable insulation in order to prevent such corrosion.

1. Where steel conduit comes in contact with aluminum conduit provide an appropriate zinc based, anti-seize compound.

M. For ethernet cable, minimum radius shall be per cable manufacturer’s requirement. If this requires custom long radius bends they shall be part of the Work.

3.2 CONDUIT

A. Provide exposed conduit manufactured of rigid aluminum.

B. Power conduit (other than VFD cable), digital control conduit, and fiber conduit encased in concrete shall be constructed of Schedule 40 PVC.

C. Analog control, VFD output cables, or instrumentation conduit encased in concrete shall be RGS conduit where the encasement is in a floor slab within the building limits.

D. Concrete Encasement

1. Where PVC or RGS conduit is stubbed up from a concrete encasement, provide a PVC-coated RGS elbow. Where the elbow remains below the slab additional conduit matching that of the elbow shall be provided for emergence of the stub-up.

2. The conduit shall emerge from the concrete in a direction perpendicular to the surface whenever possible.

3. Do not encase conduit in the bottom floor slab below grade.

E. Size

1. Provide exposed conduit of 3/4-inch minimum trade size.

2. Provide encased conduit of one-inch minimum trade size.

F. Install supports at distances required by the NEC.

G. Concrete cover for conduit and fittings shall not be less than 1-1/2 inches for concrete exposed to earth or weather, or less than 3/4 inch for concrete not exposed to weather or in contact with the ground.

H. Penetrations

1. Provide conduit passing through walls or floors with plastic sleeves. The space between the sleeve and conduit shall be sealed with fire rated material.

2. Perform core drilling in accordance with the requirements of Section 26 00 00 – Electrical Work, General.

3. Conduits passing through a slab, wall, or beam shall not significantly impair the strength of the construction.

I. Place the conduit such that cutting, bending, or displacing reinforcement from its proper location will not be required.

J. Coat threads with a conductive lubricant before assembly.

K. Joints

1. Provide joints that are tight, thoroughly grounded, secure, and free of obstructions in the pipe.

2. Adequately ream the conduit in order to prevent damage to the wires and cables inside.

3. Use strap-wrenches and vises to install the conduit, in order to prevent wrench marks on the conduit.

4. Replace conduit with wrench marks.

L. Connections

1. Make connections to motors and other equipment subject to vibration by using liquid-tight flexible conduit not exceeding 3 feet in length.

2. Provide equipment subject to vibration that is normally provided with wiring leads with a cast junction box for the make-up of connections.

M. Duct sealant shall be foam duct sealant such as **Polywater FST or approved equal.** Provide duct sealant at the following locations:

1. Where required by NEC Article 300.7.

N. Identification of Conduits

1. Identify conduits at ends and at pulling points.

2. Identification shall be the unique conduit number assigned in the Contract Documents.

3. Other than 120 VAC panelboard circuits, if a conduit has not been assigned a unique number in the Contract Documents, assign a unique number following the numbering scheme used in the Contract Documents.

4. Assign a unique number to 120 VAC panelboard circuits, similar to the cable numbering scheme used in the Contract Documents.

5. Provide conduit identification by a stamped non-corroding metal tag attached to the conduit bushing.

a. Shall be solid brass with 0.036-inch minimum thickness, raceway number stamped in 3/16-inch minimum height characters, and attached to the raceway with 316 stainless steel wire

6. Provide an engraved phenolic nameplate in accordance with the requirements of Section 26 00 00 – Electrical Work, General, or a computer printed self-adhesive label attached to the equipment or enclosure inside which the conduit terminates.

7. Markings with a pen or paint will not be accepted.

O. Identification of Pullboxes and Junction Boxes

1. Identify pullboxes and junction boxes.

2. Identification shall be the unique conduit number assigned in the Contract Documents, or if not assigned a unique number the CONTRACTOR shall assign one following the numbering scheme used in the Contract Documents.

3. Provide box identification by a stamped or engraved non-corroding metal tag or an engraved phenolic nameplate, in accordance with the requirements of Section 26 00 00 – Electrical Work, General, and attached to the box or enclosure.

4. Markings with a pen or paint will not be accepted.

P. Provide conduit for data cables in accordance with the equipment manufacturer's recommendations, especially regarding separation from low- and medium-voltage power raceways.

END OF SECTION

SECTION 26 05 73 – PROTECTIVE DEVICE STUDIES

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall perform the indicated short circuit and protective device studies for the electrical power system in accordance with the Contract Documents. The main requirement for the study is recommended settings for the two new VFD's and their MCC feeder breakers (related to the replacement pumps 2 and 4 at the Influent Pump Station) provided under this Contract and for providing arc flash labels for the new VFD's.

B. The WORK of this Section shall include protection studies for motors with solid state overload and overcurrent protection devices.

C. It is the responsibility of the CONTRACTOR to obtain the information required from the electric utility and appropriate vendors.

1.2 QUALIFICATIONS

A. Short circuit studies, protective device evaluation studies, arc-flash hazard analysis studies, and protective device coordination studies shall be performed by a manufacturer who has been regularly engaged in short circuit and protective device coordination services for a period of at least 15 years.

B. The most recent study was performed by Eaton (signed by Kevin Barnett) under General Order Number EPO0002846.1, Report Number TQSIPO0002846.1, Submitted By R Heltemes for Kellogg Creek WRRF, Portland, OR, Revision 3, September 2020. Eaton may be best suited to provide the small updates required under this Contract. A copy of the report is available but the study model files are not.

C. The indicated studies shall be signed by the professional electrical engineer, registered in the State of Oregon, responsible for the studies.

D. The studies shall utilize computer programs with proven reliability and accuracy for performing 3-phase fault-duty calculations.

1.3 CONTRACTOR SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Contractor Submittals.

1. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification

requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. The short circuit, arc-flash hazard analysis, and protective device coordination studies shall be provided prior to start-up; utilize characteristics of as-installed equipment and materials.

C. The adequacy of the equipment "withstand" and interruption ratings shall be approved by the ENGINEER.

D. Submit certification that device settings have been completed in accordance with the approved study.

1.4 MANUFACTURERS' SERVICES

A. The VFD manufacturer shall furnish the services of a qualified field engineer and necessary tools and equipment in order to test, calibrate, and adjust circuit breaker trip devices as recommended in the power system coordination study.

B. The motor control center manufacturer shall furnish the services of a qualified field engineer to calibrate the MCPs as recommended in the power system study. The CONTRACTOR shall coordinate with the existing manufacturer of the MCC.

C. All other recommended settings shall be completed by the CONTRACTOR.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

A. The studies shall include development of single-line and impedance diagrams of the power system.

B. The diagrams shall identify components considered in the study and the ratings of power devices, including transformers, circuit breakers, relays, fuses, busses, and cables.

C. The resistances and reactances of cables shall be identified in the impedance diagram.

D. The studies shall contain written data from the electric utility company regarding maximum available short circuit current, voltage, and X/R ratio of the utility power system.

E. The studies shall include every protective device and feeder included or modified within the WORK.

F. The first upstream overcurrent device outside the WORK shall be used as a fixed reference (the MCC 1A/1B main breakers).

G. The studies shall include all portions of the electrical distribution system for normal and standby power sources down to and including the 480-volt distribution system.

3.2 SHORT CIRCUIT STUDY

A. The short circuit study shall be performed with the aid of a digital computer program, and shall be in accordance with the following Standards:

ANSI/IEEE 141	Recommended Practice for Electrical Power Distribution for Industrial Plants
ANSI/IEEE 242	Recommended Practice for Protection, and Coordination of Industrial, and Commercial Power Systems
ANSI/IEEE C 37.010	Application Guide for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI/IEEE C 37.13	Low-Voltage AC Power Circuit Breakers Used in Enclosures

3.3 PROTECTIVE DEVICE EVALUATION STUDY

A. A protective device evaluation study shall be performed in order to determine the adequacy of circuit breakers, molded case switches, and fuses.

B. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the attention of the ENGINEER.

C. Do not utilize series-rated circuit breakers to meet short circuit requirements for this project.

D. Devices shall be fully rated to withstand available fault currents.

3.4 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed in order to develop the necessary calculations to select power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated current transformers, and low-voltage breaker trip characteristics and settings.

B. Any problem areas or inadequacies in the equipment due to prospective short-circuit currents shall be promptly brought to the ENGINEER's attention.

3.5 TIME/CURRENT COORDINATION CURVES

A. As a minimum, the time/current coordination curves for the power distribution system shall include the following items plotted on 5-cycle log-log graph paper:

1. Time/current curves for each protective relay, circuit breaker, or fuse demonstrating graphically that the settings will provide protection and selectivity within industry standards

2. Each curve shall be identified, and tap and time dial settings shall be specified.

3. Provide individual curves for each feeder unless identical to others.

4. Selectivity

a. Time/current curves for each device shall be positioned to provide the maximum selectivity to minimize system disturbances during fault clearing.

b. Where selectivity cannot be achieved, the ENGINEER shall be notified as to the cause.

c. Recommendations shall be included for alternate methods that would improve selectivity.

d. Note: The Contract Documents may require protective devices to have an Instantaneous settings which is defeatable. In this case, “LSIG” may be called out on the Contract Drawings. This is not indication that “I” shall be utilized. Upstream and downstream instantaneous settings may result in non-selectivity. Where selectivity is improved due to disabling the upstream instantaneous feature it shall be considered in the study. Where this does occur, for arc flash reduction maintenance modes the instantaneous shall be re-enabled where possible and where it shows improvement.

5. Time/current curves and points for cable and equipment damage.

6. Circuit interrupting device operating and interrupting times

7. Indicate maximum fault values on the graph.

8. Sketch of bus and breaker arrangement

9. Magnetizing inrush points of transformers

10. Thermal limits of dry-type and liquid-insulated transformers (ANSI damage curve)

11. Every restriction of the ANSI and National Electrical Code shall be followed, and proper coordination intervals and separation of characteristics curves shall be maintained.

3.6 ARC FLASH STUDY

A. An arc flash study shall be performed with the aid of a digital computer program in order to determine the “Arc Flash Protection Boundary” and “Personal Protective Equipment” (PPE) levels for applicable electrical distribution equipment, and VFDs in the power distribution system.

B. The arc flash study shall be performed in conjunction with short circuit calculations and protective device coordination.

C. The arc flash study shall be in accordance with the latest version of the following Standards:

1. NFPA 70E Standard for Electrical Safety Requirements for Employee Workplaces

2. IEEE 1584 IEEE guide for performing Arc Flash Hazard Calculations

3. OSHA (29 CFR PART 1910) Occupational Safety and Health Standards for General Industry

4. ANSI Z535.4 Product Safety Signs and Labels

D. The recommended values for the “Arc Flash Protection Boundary” and PPE levels, based on the arc flash study results, shall be tabulated in the study.

E. Labeling

1. The digital computer program shall provide the “Arc Flash Protection Boundary” and PPE values in a format that can be directly printed on to labels.

2. Where there is a maintenance switch (which reduces arc flash energy) the CONTRACTOR shall provide two labels. One label shall be for when the maintenance switch is on and one shall be for when the maintenance switch is off. Where there are multiple maintenance mode switches, the label shall be clear which maintenance mode switch enables the reduced settings..

3. The CONTRACTOR shall provide these labels in accordance with Section 26 00 00 – Electrical Work, General.

3.7 FINAL SUMMARY REPORT

A. Summarize the results of the indicated power system studies in a final report.

B. The report shall include the following items:

1. Single-line diagram

2. Impedance diagram with fault current numbers at buses and loads

3. Tabulation of all protective devices identified on the single line diagram

4. Time/current coordination curves

5. Specific recommendations, if any

6. Test instrumentation, condition, and connections, as applicable, for each study

7. Computerized fault current calculations

8. Any suggested changes to the protection scheme or equipment selection that will result in improved system reliability and safety

9. Recommendations to minimize the arc flash energy

C. The report shall include information concerning the computer program used for the study, as well as a general discussion of the procedure, items, and data considered in the preparation of the study.

D. Submit four (4) bound copies of the report to the ENGINEER, and one (1) electronic PDF version.

3.8 PROTECTIVE DEVICE TESTING, CALIBRATION, AND ADJUSTMENT

A. Test, calibrate, and adjust the protective relays and circuit breaker trip devices in accordance with the recommendations in the power system coordination study.

B. Calibrate the MCPs as in accordance with the recommendations in the power system study.

C. Adjustments shall be made prior to energizing any electrical equipment.

END OF SECTION

SECTION 26 29 23 – VARIABLE FREQUENCY DRIVE UNITS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. General

1. The CONTRACTOR shall provide the variable frequency drive (VFD) units, complete and operable, as indicated in accordance with the Contract Documents. The CONTRACTOR shall be responsible for all programming, startup/testing, and training.

2. The CONTRACTOR shall provide equipment pad modifications as required to mount the VFD at the existing Pump 2 and Pump 4 VFD locations.

   a. The VFD shall be installed with seismic anchoring adequate for the project site. See 26 00 00 – Electrical Work, General for seismic requirements.

   b. The CONTRACTOR shall provide anchoring calculations stamped by an Oregon Professional Engineer.

3. It is the intent of this Section to require complete, reliable, and fully tested variable frequency drive systems suitable for attended or unattended operation.

4. The variable frequency drive (VFD) units and components specified herein shall be mounted in a NEMA 12 cabinet enclosure.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 –Contractor Submittals, and Section 26 00 00 – Electrical Work, General.

1. Include with each submittal a copy of this specification section, with addenda updates included, and all referenced and applicable sections included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The ENGINEER shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

B. Include a copy of the Schematic Diagram drawings marked to show specific changes necessary for the equipment proposed. If no changes are required mark “no changes required”. If deviations are requested a written explanation is required for the OWNER’s consideration.

C. Custom prepare shop drawings. Cross out all options not proposed to be included with the equipment.

D. Shop Drawings: Include the following information:

1. Equipment Information

    a. Name of drive manufacturer

    b. Type and model

    c. Assembly drawing and nomenclature

    d. Maximum heat dissipation capacity in kW

2. Provide data on the 18-pulse phase-shifting transformer.

3. Conduit entrance provisions and access plates. The VFD shall have top entry for power cables from MCC and be bottom exit for power cables to pump. Control cables shall have top and bottom entry locations available.

4. Circuit breaker type, frames, and settings

5. Confirmation of 65 KAIC short circuit rating

6. Information related to relays, timers, pilot devices, control transformer VA, and fuse sizes, including catalog cuts

7. Enclosure dimension drawings (front/side/rear/top) and front panel layout. Confirm that the dimensions of the proposed equipment will fit into the space allocated. Maximum enclosure dimensions shall be 48” W x 32” D x 93.5”H. VFD shall be front accessible only.

8. Ladder Diagram

    a. Submit the system schematic ladder diagram and interconnection diagrams.

    b. The schematic ladder diagram shall include remote devices.

    c. The ladder diagram shall incorporate the control logic on the corresponding elementary schematic as indicated.

    d. Submittals with drawings not meeting this requirement will not be reviewed further and will be returned as "REJECTED."

9. Information for dV/dT devices. The dV/dT device shall be mounted within the VFD enclosure.

10. The CONTRACTOR shall confirm the controller is matched to the load (variable torque or constant torque) as well as the speed and current of the actual motor being controlled. This shall be done for each load on a case-by-case basis.

11. Factory test data certifying compliance of similar equipment from the same manufacturer with requirements of this Section.

12. Ground location shall be marked.

13. Nameplates shall be engraved with white letter on black face. Provide main nameplate as well as control/pilot devices.

14. Method of anchoring and weight.

15. Internal wiring type, conductor size and insulation color.

16. Identification of panel-mounted devices, conductors, and electrical components shall be in accordance with Section 26 00 00 – Electrical Work, General. Shop drawing identification shall match actual identification to be provided.

E. The Technical Manual shall include the following documentation:

1. Manufacturer's standard warranty

2. Field test report

3. Programming procedure and program settings including a copy of the programmed settings.

4. As-built/as-left drawings

F. Spare Parts List

1. Submit information for spare parts recommended by the controller manufacturer.

PART 2 -- PRODUCTS

2.1 GENERAL

A. The CONTRACTOR shall provide variable frequency drives as outlined in the table. Equipment to be operated through variable frequency drives is as follows:

Quantity	Equipment	HP	Motor Amps	Constant or Variable Torque (C/V)	VFD Rated Amps	RPM	Bypass (Y/N)	Enclosure Type
2	Pump (Flygt NT 3400.746)	170	210	V	242 minimum	880	N	NEMA 12

2.2 EQUIPMENT

A. General

1. The power supply shall be an adjustable frequency inverter designed to convert incoming 3-phase, 480-volt, 60-Hertz power to a DC voltage and then to adjustable frequency AC by use of a 3-phase inverter.

2. Current-source inverters will not be accepted.

3. The CONTRACTOR shall be responsible for matching the controller to the load (variable torque or constant torque) as well as the speed and current of the actual motor/s being controlled.

4. The CONTRACTOR shall provide "clean power" 18-pulse VFD's meeting IEEE-519 limits at the input terminals to the VFD.

5. VFD's shall be rated not less than 65 KAIC at 480 VAC.

6. The VFD's shall be UL 508 listed.

7. The VFD's will be located in a NEMA 12 environment which may be subject Hydrogen Sulfide gas. Provide conformal coating to the extent it is available.

B. Inverter

1. The inverter shall be of a voltage-source design, producing a pulse-width-modulated type output.

2. Six-step and current-source inverters will not be accepted.

3. Inverters shall be capable of delivering the nameplate horsepower exclusive of service factor without the need for mandatory thermostats or feedback tachometers.

4. The VFD shall vary both the AC voltage and frequency simultaneously in order to operate the motor at required speeds.

C. The minimum VFD inverter efficiency shall be 95 percent at 100 percent speed and load, and 85 percent efficiency at 50 percent speed and load.

D. Fans mounted within the VFD enclosure shall be thermostatically controlled, and powered from the CPT in the enclosure. Separately powered fans are not acceptable.

E. Power Outage

1. The VFD shall shut down in an orderly manner when a power outage occurs on one or more phases.

2. Upon restoration of power and a START signal, the motor shall restart and run at the speed corresponding to the current process input signal. The VFD shall not lock out or require a manual reset due to a power failure condition.

3. Provide a reset timer as shown on the Schematic Diagrams of the Contract Drawings where the VFD requires an external input upon power restoration.

F. The VFD shall be provided with the following features:

1. Inrush current adjustment between 50 and 110 percent of motor full load current (factory set at 100 percent)

2. Overload capability at 110 percent for 60 seconds for variable torque loads and 150 percent for constant torque loads.

3. Adjustable acceleration and deceleration

4. Input signal of 4 - 20 mA from process

5. Output speed signal of 4 - 20 mA; Signals other than 4 - 20 mA will not be accepted.

6. Upon loss of input signal, the VFD shall operate at a preset speed.

7. A minimum of 2 selectable frequency jump points in order to avoid critical resonance frequency of the driven system.

8. Additional devices and functions as indicated in the Contract Drawings and herein.

G. The VFD shall be provided with, as a minimum, the following protection features:

1. Input line protection with metal oxide varistor (MOV) and RC network

2. Protection against single phasing

3. Instantaneous overcurrent protection

4. Electronic overcurrent protection

5. Ground fault protection

6. Overtemperature protection for electronics

7. Protection against internal faults

8. Ability to start into rotating motor (forward or reverse rotation)

9. Additional protection and control as indicated and as required by the motor and driven equipment

10. dV/dT devices shall be provided as required and noted in Part 1.

H. The VFD shall be designed and constructed to satisfactorily operate within the following service conditions.

1. Elevation

a. Elevation to 3300 feet

b. For elevation greater than 3300 feet, the VFD shall be derated in accordance with the manufacturer's recommendation

2. Ambient Temperature: 0 to 40 degrees C

3. Humidity: 0 to 95 percent, non-condensing

4. AC Line-Voltage Variation: plus 10 percent to minus 10 percent

5. AC Line-Frequency Variation: plus and minus 2 Hertz

I. Electrical equipment provided in addition to the adjustable frequency inverter for each drive shall include:

1. 18-pulse phase shifting transformer.

2. dV/dT device.

3. Input surge protective device

4. Fused 480-to-120-volt control transformer to provide system control power for the VFD and its devices as indicated on the Contract Drawings. Provide a blown fuse indicator for the control power transformer.

5. Provide an input circuit breaker padlockable from the exterior.

J. Inverter Signal Circuits- See Schematic Diagram Contract Drawings for pump VFD I/O requirements. Note that only those features shown on the OIT may be incorporated into the HMI / Keypad.

1. The inverter signal circuits shall be isolated from the power circuits and shall be designed to accept an isolated 4-20 mA signal in the automatic mode of operation.

2. The inverter shall follow the speed setting of the HMI / keypad while in the manual mode.

3. Refer to the Schematic Diagrams indicated on the Contract Drawings for speed control and START/STOP methods.

4. Access to set-up and protective adjustments shall be protected by key-lockout.

5. The following operator monitoring and control devices for the inverter shall be provided on the face of the VFD enclosure as discrete devices (not as part of a multi-function microprocessor-based keypad access device):

a. HAND/OFF/AUTO selection from a remote logic relay or switch

b. Reset pushbutton

c. POWER ON, RUN , FLYGT PUMP PROTECTION RELAY SHUTDOWN (ALARM A), and FAIL indicating lights.

d. Elapsed time meter

e. Provide other controls and readouts normally furnished as standard equipment, or as otherwise indicated on the Schematic Diagrams in the Contract Drawings.

K. Multi-function microprocessor-based keypad access device shall be door mounted and shall have NEMA rating matching that of the enclosure.

L. Pilot devices, control relays, time delay relays, be as follows:

1. Pushbuttons, selector switches, and pilot lights shall be the heavy-duty, oil-tight type, NEMA 4X/13, sized to 30-mm. Miniature style devices are not acceptable. Devices shall be as manufactured by **General Electric, Eaton Electrical, Square D,** or equal.

   a. Lens colors shall be red for "run," "open," or "on"; green for "stopped," "closed," or "off"; white for “Power On”; and amber for alarm.

   b. Pilot lights shall be full voltage, push-to-test, LED cluster type.

2. Relays shall be 3 PDT (additional poles as required by Contract Drawings) with 10 amp contacts, plug-in type with indicating light, rectangular blades and provided with sockets for screw-type termination and hold-down clips. Relays shall be as manufactured by **Square D, Potter Brumfield,** or equal.

3. Elapsed time meters shall be non-resettable type, read to a maximum of 99999.9 hours and shall be as manufactured by **General Electric, Eaton Electrical,** or equal.

4. Time delay relays shall be combination on delay and off delay (selectable) with adjustable timing ranges. Provide socket with screw terminal connections and retaining strap. Time delay relays shall be **Square D, ATC, Eaton Electrical,** or equal.

M. Flygt MAS-801 Pump Protection System:

1. The Flygt MAS-801 pump protection “base unit” (from 43 25 06 – Dry-Pit Submersible Solids-Handling Pumps) shall be provided within the VFD cabinet under this Contract. The “base unit” is 1.73”W x 4.80”H x 4.45”D. Terminals shall be clearly marked for wiring as shown in the Contract Drawings. All control relays, pilot lights and power supplies shall be provided under this Contract.

2. The Flygt MAS-801 pump protection “base unit” will accept the pump control wiring which is embedded within the pump power cable. The “base unit” will then communicate with a Flygt MAS-801 “central unit” and HMI screen provided under this contract and located separate from this VFD.

3. The Flygt MAS-801 Power Analyzer (PAN 312) option unit shall have space reserved for mounting within the VFD cabinet under future Contract. Provide space (4.25”W x 3.55”H x 2.53”D) for the “PAN 312” unit within the VFD and terminals clearly marked for wiring as shown in the Contract Drawings. CT’s (from 43 25 06 – Dry-Pit Submersible Solids-Handling Pumps) and power supply shall be provided under this Contract as shown in the Contract Drawings.

4. Refer to Attachment A and Attachment B at the end of this Section for information on the MAS-801 components.

2.3 SPARE PARTS

A. Provide recommended spare parts list only.

2.4 Manufacturers

A. The Owner and Engineer believe the following candidate manufacturers are capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. VFD's shall be installed in the custom enclosures as specified and candidate manufacturers include:

1. **Eaton (DG1 inverter)**

2. ABB

3. Siemens

PART 3 -- EXECUTION

3.1 MANUFACTURER'S SERVICES

A. General

1. An authorized service representative of the manufacturer shall be present at the Site for 3 Days to furnish the services listed below.

2. For the purpose of this Paragraph, a Day is defined as an 8-hour period excluding travel time.

B. The authorized service representative shall supervise the following and shall certify that the equipment and controls have been properly installed, aligned, and readied for operation. The CONTRACTOR shall coordinate having the Manufacturer's Authorized Representative and the CONTRACTOR together for VFD installation and the Manufacturer's Authorized Representative, the CONTRACTOR, and the Integrator for testing and startup:

1. Installation of the equipment

2. Inspection, checking, and adjusting the equipment

3. Startup and field testing for proper operation

4. Performing field adjustments such that the equipment installation and operation comply with requirements

C. Instruction of OWNER's Personnel

1. The authorized representative shall instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with test equipment.

2. The instruction shall be specific to the VFD models provided.

3. Training shall be scheduled a minimum of 3 weeks in advance of the first session.

4. Training shall include individual sessions for 2 shifts of plant personnel.

5. Proposed training materials shall be submitted for review, and comments shall be incorporated.

6. Training materials shall remain with the trainees.

7. The OWNER may videotape the training for later use with the OWNER's personnel.

3.2 INSTALLATION

A. Conduit stub-ups for interconnected cables and remote cables shall be located and terminated in accordance with the drive manufacturer's recommendations.

B. Establish proper direction of rotation for the motor controlled by the drive. Verify that the VFD is precluded from operating in a direction that can damage the driven equipment. Change motor or VFD power lead connection and not the AFD direction, where rotation is incorrect.

C. Verify that the drive will operate properly both in the “manual speed control mode” and in the “remote or automatic mode” from a remote speed signal input.

D. Programming

1. The authorized service representative shall perform programming of drive parameters required for proper operation of the VFDs included in this project.

2. The CONTRACTOR shall utilize the VFD manufacturer’s services to perform complete programming of drive parameters required for proper operation of the VFD's included in this project. Submit records of programming data in the equipment Technical Manual, including “as-installed” setup and protective settings. Manuals must be provided to OWNER by the time any type of completion milestone is addressed. Once the OWNER takes possession, they must have the manuals.

3. The VFD manufacturer’s services shall include adjusting protective devices in accordance with 26 05 73 – Protective Device Studies.

4. Set parameters and carrier frequency for existing motors to avoid insulation damage.

5. Set the minimum and maximum speeds and the acceleration and deceleration “ramps” recommended by 43 25 06 including any frequency jump points that must be avoided.

E. Tag with appropriate arc flash labels.

3.3 FIELD TESTING

A. Testing, checkout, and startup of the VFD equipment in the field shall be performed under the technical direction of the manufacturer's service engineer.

B. Under no circumstances shall any portion of the drive system be energized without authorization from the manufacturer's representative.

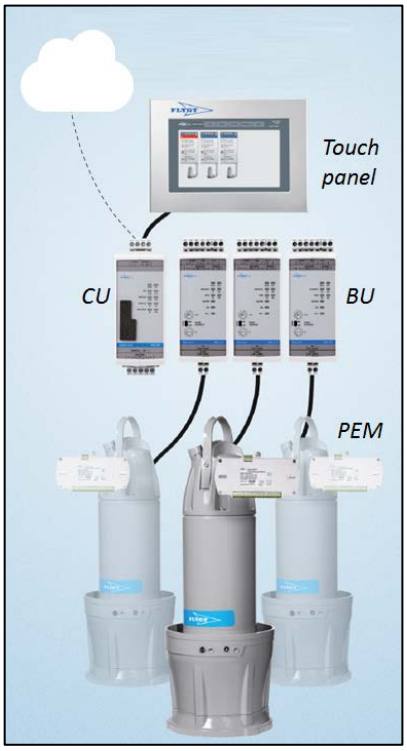
C. Verify proper operation of control logic in every mode of control.

END OF SECTION

MAS 801 Pump monitoring system

The Flygt MAS 801 is a pump monitoring system designed to remember, record and present pump events quickly and easily. As part of a complete Flygt pumping system, it helps reduce costs over the pump's lifetime by facilitating maintenance and assuring safe operation, thereby increasing reliability and availability.

Detailed operation data can be accessed via MAS 801 for immediate analysis using a local touch panel or by using a standard web browser on a PC (no special software required). Alternatively data is transferred to a higher level system such as a SCADA system (Supervision Control and Data Acquisition) or a cloud service.



Sensor cable not needed
The pump contains an electronic module (PEM) to which all pump sensors are connected. Measurement signals are sent to a unit in the control cabinet on two screened and twisted leads integrated in the power cable. In this manner, the conventional sensor cable becomes redundant, simplifying handling and improving quality.

Everything you need to know
MAS 801 keeps and provides information to protect the pump and give the user full control via a graphical touch panel or PC. In the event of an alarm, there are tools for root cause analysis and suggestions for remedy. The base is extensive monitoring and logging comprising temperature measurement in six spots. Leakage is monitored in up to three compartments depending on pump type. A pump electronic module contains an integrated 3-axis vibration sensor as standard. A current transformer makes sure pump current, speed and running time are always recorded.

'Plug-n-play' and streamlined service
The pump electronic module holds factory configuration data speeding up installation. Serial number and name plate data are key to the Flygt Service Guide and for spare parts ordering. Service records and operational data are used to determine the pump's status, leading to timely and optimized service and maintenance.

Communication options
With its ethernet, Modbus (TCP / RTU) and modem communications ports, MAS 801 can communicate with most Supervision Control And Data Acquisition (SCADA) systems on the market.

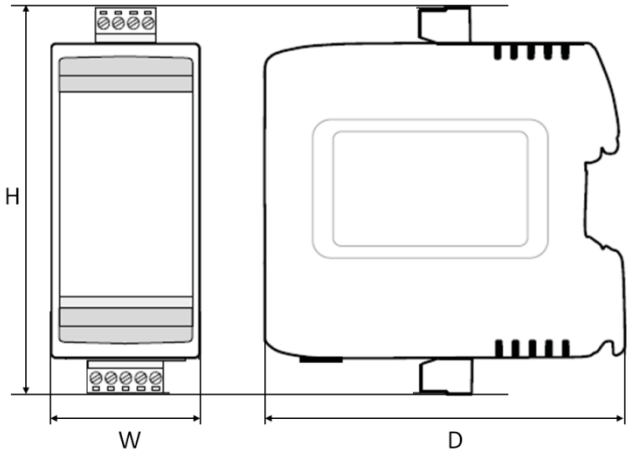
The MAS 801 also contains two relays, one of which is used to stop the pump in case of a serious fault and another that can be used to indicate a warning.

With the many functions and features of MAS 801, you have Flygt's decades of knowledge and experience in monitoring and control of submersible pumps literally at your fingertips.

Part number	MAS 801 System detail
823 07 00	Central unit (CU)
823 06 00	Base unit (BU)
822 48 00	FOP 402 - 7 inch touch panel
823 05 00	Pump Electronic Module (PEM) (part of the pump)

Applicable pump models
3153 – 3315
3231 – 3800
7020 – 7900
5100, 5150, 5570

MAS 801 Central unit (CU)



One CU handles up to a maximum of ten pumps. The CU is an information hub, storing data from all pumps and provides it for presentation and export. Embedded web pages called “Configuration and Analysis Tool”, are accessed with a browser via a PC or a touch display for human interaction.

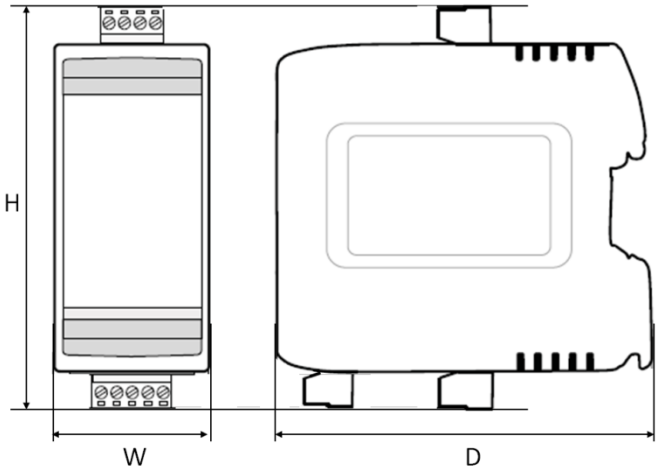
Technical data

Power supply	24 V DC, -15 to +20%
Supply dropout	50 ms without function disruption
Uninterrupted power supply	Recommended if a long startup time must be avoided.
Power consumption	Max 10 W
Ambient temperature	-20°C to +65°C (-4°F to +149°F)
Storage temperature	-10°C to +75°C (14°F to +167°F)
Humidity	RH 90% (non-condensing)
Ingress protection	IP20
Outer dimensions (W x H x D)	45 x 122 x 113 mm (1.77 x 4.8 x 4.45) inches
Approvals	CE, cURus (E492775), cCSAus (013533)

Communication

LAN, RJ45 - socket	Access of embedded web pages with a PC point-to point, via LAN or the Internet.
Display, RJ45 – socket	Access of embedded web pages with a touch HMI.
Modbus TCP	External communication using RJ45-socket LAN.
Modbus RTU	Terminals A+, B- and ground (Modbus slave). For external communication, e.g. Flygt MultiSmart or PLCs.
DeviceNet	Communication with base units (five terminals). Requires 24 V DC external supply voltage.
USB – socket in front	Type A for data download or upgrade of firmware using a USB stick.

MAS 801 Base unit (BU)



There is one BU per pump and its main task is to relay information between the pump electronic module (PEM) and the central unit. Upon request from the PEM, the BU can stop the pump by opening a relay used for interlock of the pump contactor coil. In case a PAN 312 is used, it is connected to the BU.

Technical data

Power supply	24 V DC, -15 to +20%
Supply dropout	50 ms without function disruption
Power consumption	max 10 W
Ambient temperature	-20°C to +65°C (-4°F to +149°F)
Humidity	RH 90% (non-condensing)
Ingress protection	IP20
Outer dimensions (W x H x D)	45 x 122 x 113 mm (1.77 x 4.8 x 4.45) inches
Approvals	CE, cURus (E492775), cCSAus (013533)
Mounting	DIN-rail (35 x 7.5 mm)

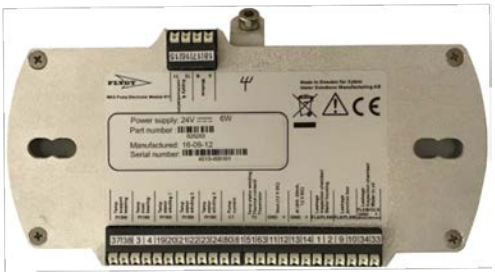
Relays and I/Os

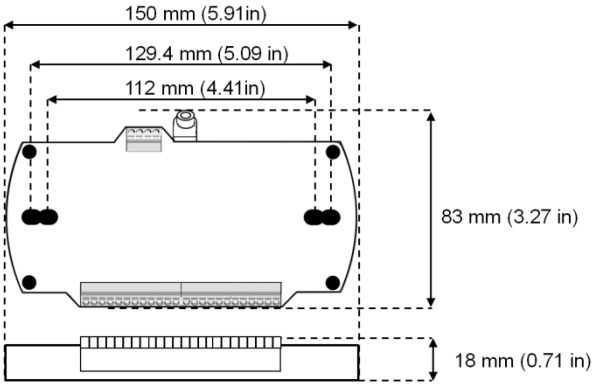
GO-relay for interlock	250 V AC, 8(3) A (normally open)
A-alarm relay	250 V AC, 4 A (normally open)
DI 1 - Digital input	12 V DC output. For connection of a volt free contact. Configurable for alarm input or alarm reset.

Communication

PEM – Two wire communication	For supply of the pump electronic module (PEM) and for bus communication using a proprietary protocol.
DeviceNet	Communication with central unit (five terminals). Requires 24 V DC external voltage supply.
Modbus RTU	Terminals A+, B- (Modbus master). For connection to Flygt products: PAN 312 or SmartRun.

Pump Electronic Module (PEM)





The pump electronic module interfaces all pump sensors. Measurements are digitized, stored and communicated to the CU via the BU. Data plate information and monitoring settings are stored at the factory. PEM monitors measurement values and sends alarms in the form to the BU and CU.

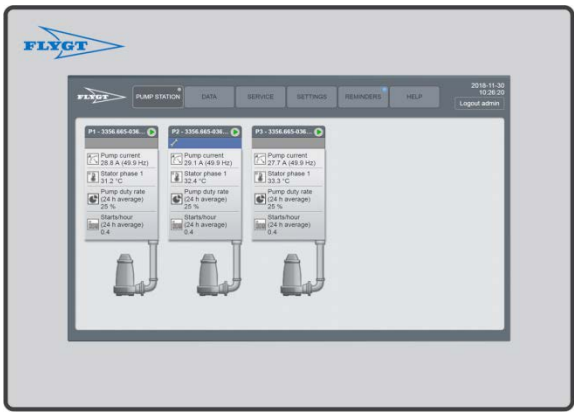
Technical data

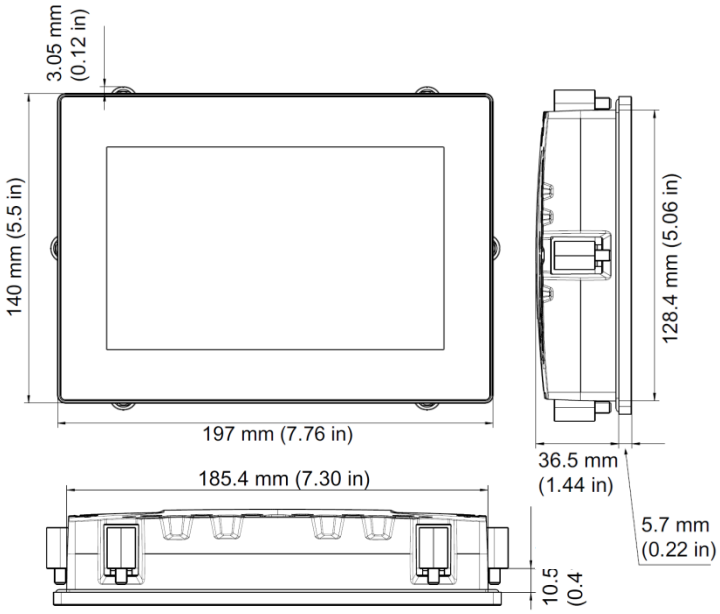
Power supply	See “Supply and communication”
Ambient temperature	-20°C to +125°C (-4°F to +257°F), except built-in accelerometer: -40°C to +105°C (-40°F to +221°F)
Ingress protection	IP20. If soaked, check and consider replacement.
Approvals	CE, cURus (E492775), cCSAus (013533)
Thermal contacts/PTC-thermistor	Short circuit warning (thermistor)
Pt100 inputs (5)	Inaccuracy: +/-0.5+0.01 T (temperature in °C) Short circuit and interruption warning
Leakage sensor inputs (3)	12 V DC, current sensing Values of operation: I < 3 mA — Broken circuit 3 < I < 22 mA — OK 22 < I < 55 mA — Leakage I > 55 mA — Short circuit
0/4-20 mA configurable	24 V DC, inaccuracy: +/- 1,5%
Current transformer input	For current transformer, 300:1 A, (part no 82 62 75) Inaccuracy: +/-1,5%
Vibration sensor, 3-axis	Integrated micro electro mechanical system (MEMS)
Mounting	G&G: On terminal plate 777 04 00 Midrange, Slimline: At the bottom of the junction box.

Communication

Supply & communication	Supply of the PEM (24 V DC) and for communication with the BU using a proprietary protocol.
Chassis ground	For the SUBCAB two-wire element screen.
Modbus	Unused.
USB port	Unused.

FOP 402





FOP 402 is a touch screen connected to the MAS 801 central unit. It is used for human interaction with the configuration and analysis tool (web pages embedded in the CU).
The HMI is installed on a wall or in a cabinet door.

Technical data

Power supply	24 V DC (-15% to +20%)
Power consumption	max 8.5 W
Ambient temperature	-20°C to +60°C (-4°F to +140°F)
Storage temperature	-30°C to +80°C (-4°F to +176°F)
Humidity	RH 90% (non-condensing)
Ingress protection	IP20, back side
	IP65, front side
Outer dimensions	See picture above.
Approvals	CE, UL

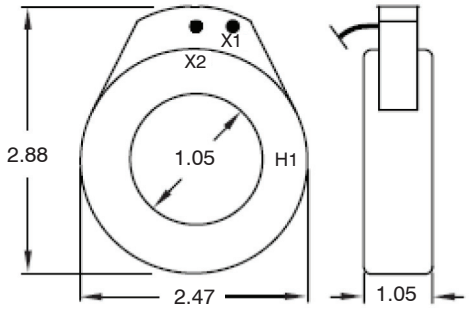
Display data

Display	7” TFT LED, resolution 800 x 480 pixels
Brightness	500 cd/m2
Contrast ratio	600:1
Colors	16.7 M
Touch-panel type	Multi-touch, PCT

AC Current Transformer

Model AL and 7RL (with 5 amp secondary rating)

AL



For AL models

All Dimensions in inches

Typical Application:

Flygt Current Transformers (CT) are used with Flygt Monitoring Control products to read motor current levels. The CTs listed below are used specifically with the MultiSmart Controllers with Motor Protection (3MP/6MP) and the PAN312 Power analyzer. Both the MultiSmart and PAN312 applications require three CT's per pump for three phase monitoring.

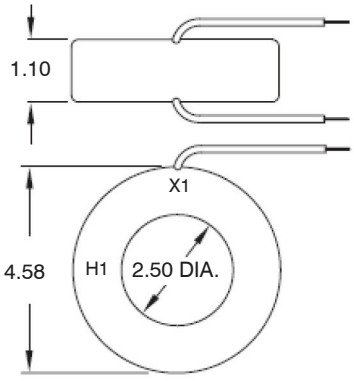
Frequency:
50 - 400 Hz

Insulation Level:
600 volts, 10kv BIL full wave.

Rating Factor:
2.0 @ 30° C amb.

- Flexible leads are UL 1015 105°C, CSA approved # 16 AWG, 24" long.
- Approximate weight: AL models: 1.0 lb.
  7RL models: 1.5 lb.

7 RL



For 7RL models

All Dimensions in inches

Flygt Part #	Current Ratio	Accuracy at 60Hz	Burden VA at 60 Hz	Model
14-404121	50:5	+/- 5%	1.0	AL
14-404125	100:5	+/- 3%	2.0	AL
14-404128	150:5	+/- 2%	2.0	AL
14-404130	200:5	+/- 2%	3.0	AL
14-404131	250:5	+/- 1%	5.0	7RL
14-404132	300:5	+/- 1%	5.0	7RL
14-404133	400:5	+/- 1%	7.5	7RL
14-404134	500:5	+/- 1%	10.0	7RL
14-404135	600:5	+/- 1%	12.5	7RL
14-404136	750:5	+/- 1%	17.5	7RL
14-404137	800:5	+/- 1%	20.0	7RL
14-404138	1000:5	+/- 1%	25.0	7RL
14-404139	1200:5	+/- 1%	35.0	7RL

SECTION 33 92 10 - STEEL PIPE, SPECIALS, AND FITTINGS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide steel pipe, specials, and fittings, complete and in place, in accordance with the Contract Documents.

B. A single pipe manufacturer shall be made responsible for furnishing steel pipe, specials, fittings, and appurtenances such as bolts and gaskets for the WORK.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.

B. Furnish the following information with Shop Drawings:

1. certified dimensional drawings of fittings and appurtenances

2. joint and pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size, and area of reinforcement; coating and lining holdbacks, manufacturing tolerances, and other pertinent information required for the manufacture of the product

3. joint details where deep bell or butt strap joints are required for control of temperature stresses

4. details for elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials that indicate amount and position of reinforcement

5. fittings and specials, showing proper reinforcement to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated

6. material lists and steel reinforcement schedules that describe materials to be utilized, including metallurgical, chemical, and physical test reports from each heat of steel to verify the steel conforms to the indicated requirements

7. line layout and marking diagrams which indicate the specific number of each pipe and fitting, the location of each pipe, the direction of each fitting in the completed line, and the following:

a. the pipe station and invert elevation at every change in grade or horizontal alignment

b. the station and invert elevation to which the bell end of each pipe will be laid

c. elements of curves and bends, both in horizontal and vertical alignment

d. the limits within each reach of restrained and/or welded joints or of concrete encasement

e. location and dimensional allocations for each indicated valve, fitting, and appurtenance

8. Welds

    a. Submit full and complete information regarding location, type, size, and extent of welds.

    b. The Shop Drawings shall distinguish between shop and field welds.

    c. Shop Drawings shall indicate by welding symbols or sketches the details of the welded joints and the preparation of parent metal required to make them.

    d. Joints or groups of joints in which welding sequence or technique are especially important shall be carefully controlled to minimize shrinkage stresses and distortion.

9. rubber gasket joint design and details

10. drawings showing the location, design, and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining

11. details and locations of closures for length adjustment and for construction convenience

12. detail drawings indicating the type, number, and other pertinent details of the slings, strutting, and other methods proposed for pipe handling during manufacturing, transport, and installation

C. Certifications:

1. The CONTRACTOR shall furnish a certified affidavit of compliance for pipe and other products or materials in AWWA C200 - Steel Water Pipe 6 in and Larger, AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 in and Larger-Shop Applied, AWWA C116 – Protective Fusion Bonded Epoxy Coatings, AWWA C207 - Steel Pipe Flanges for Waterworks Service - Sizes 4 In Through 144 In, AWWA C208 - Dimensions for Fabricated Steel Water Pipe Fittings, AWWA C218 - Coating the Exterior of Aboveground Steel Water Pipelines and Fittings, AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe, AWWA C221 - Fabricated Steel Mechanical Slip-Type Expansion Joints, and C222 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipelines and Fittings, and the following supplemental requirements:

    a. physical and chemical properties of steel

    b. hydrostatic test reports

    c. results of production weld tests

    d. sand, cement, and mortar tests

    e. rubber gasket tests

    f. records of coating application

2. Performance and payment for sampling and testing necessary for certification are the CONTRACTOR's responsibility as part of the WORK.

D. Manufacturer's Qualifications

1. Furnish a copy of manufacturer's certification to ISO 9000, SPFA, or LRQA, and documentation of manufacturer's experience in fabricating AWWA C200 pipe.

E. Design Calculations of Fittings and Specials

1. Furnish a copy of the design calculations for fittings and specials including miters, welds, and reinforcement, prior to manufacture of the pipe, fittings, and specials.

1.3 QUALITY ASSURANCE

A. Pipe Manufacturer Qualifications

1. The pipe manufacturer shall be certified to ISO 9000, the Steel Plate Fabricator's Association (SPFA), or Lloyd's Register Quality Assurance (LRQA), and shall be experienced in fabrication of AWWA C200 pipe of similar diameters, lengths, and wall thickness to this WORK.

2. Experience shall be in the production facilities and personnel, not the name of the company that owns the production facility or employs the personnel.

B. Inspection

1. Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of AWWA C200, and C205, as supplemented by the indicated requirements.

2. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing start date not less than 14 Days prior to the start of any phase of the pipe manufacture.

C. Tests

1. Except as indicated otherwise, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of AWWA C200, and C205 as follows and as applicable:

a. Joint gaskets shall be tested in accordance with AWWA C200.

b. Shop Tests

1) After the joint configuration is completed and prior to lining with cement mortar, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 75 percent of the yield strength of the steel.

2) The test pressure shall be held for 2 minutes and the pipe visually inspected to confirm that welds are sound and leak-free.

c. In addition to the tests required in AWWA C200, weld tests shall be conducted on each 5,000-feet of production welds and at any other times there is a change in the grade of steel, welding procedure, or welding equipment.

d. Fittings fabricated from straight pipe previously passing a hydrostatic test need not have an additional hydrostatic test, provided that the welds are tested by nondestructive means and are demonstrated to be sound.

D. Shop Testing of Steel Plate Specials

1. If any special has been fabricated from straight pipe not previously tested and is of the type listed below, the special shall be hydrostatically tested with a pressure equal to 1-1/2 times the design working pressure: bends, wyes, crosses, tees with side outlet diameter greater than 30 percent of the main pipe diameter, and manifolds.

2. Specials not required to be hydrostatically tested shall be tested by liquid dye penetrant inspection method in accordance with ASTM E 165 - Standard Test Methods for Liquid Penetrant Examination, Method A, or the magnetic particle method in ASME Section VIII, Division 1, Appendix VI.

3. Reinforcing plates shall be tested by the solution method using approximately 40 psig air pressure introduced between the plates through a threaded test hole; the test hole shall be properly plugged following successful testing.

4. Weld Imperfections

a. Weld defects, cracks, leaks, distortion, or signs of distress during testing shall require corrective measures.

b. Weld defects shall be gouged out and re-welded.

c. After corrections, the special shall be retested.

5. Test Heads

a. Where welded test heads or bulkheads are used, extra length shall be provided to each opening of the special.

b. After the removal of each test head, the special shall be trimmed back to the design points with finished plate edges ground smooth, straight, and prepared for the field joint.

6. Testing shall be performed before joints have been coated or lined.

7. Ultrasonic examination shall be performed in accordance with the following:

a. Steel plate that will be in welded joints or welded stiffener elements shall be examined ultrasonically for laminar discontinuities where both of the following conditions exist:

1) any plate in the welded joint has a thickness exceeding 1/2 inch

2) any plate in the welded joint is subject to transverse tensile stress through its thickness during the welding or service

b. Ultrasonic examination may be waived where joints are designated to minimize potential laminar tearing.

c. The ultrasonic examination shall be in accordance with ASTM A 578 - Straight Beam Ultrasonic Examination of Plain and Clad Steel Plates for Special Applications, with a Level I acceptance standard.

8. Plates that are not in conformance with the acceptance criteria in ASTM A 578 may be used in the WORK if the areas that contain the discontinuities are a distance at least 4 times the greatest dimension of the discontinuity away from the weld joint.

E. The CONTRACTOR shall be responsible for performing and paying for the indicated material tests.

F. The ENGINEER has the right to witness testing conducted by the CONTRACTOR, provided that the CONTRACTOR's schedule is not delayed for the convenience of the ENGINEER.

G. Additional Testing

1. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including mortar lining and coating for testing by the OWNER.

2. The additional samples shall be furnished as part of the WORK.

H. Field Testing

1. Field testing shall be in accordance with the requirements of Section 01 75 00 – Pressure Pipe Testing and Disinfection.

I. Welding Requirements

1. Welding procedures used to fabricate and install pipe shall be prequalified under the provisions of ANSI/AWS D1.1 - Structural Welding Code-Steel, or the ASME Boiler and Pressure Vessel Code, Section 9.

2. Welding procedures shall be required for 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.

J. Welder Qualifications

1. Welding shall be performed by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used.

2. Welders shall be qualified under the provisions of ANSI/AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9 by an independent local, approved testing agency not more than 6 months prior to commencing WORK on the pipeline.

3. Machines and electrodes similar to those used in the WORK shall be used in qualification tests.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Lined and coated steel pipe and specials shall conform to AWWA C200, C205, C209, and C222, C116 subject to the following supplemental requirements:

1. The pipe, specials, and fittings shall be of the diameter and class indicated and shall be provided complete with rubber gaskets or welded joints as indicated.

2. For pipe, specials, and fittings 14-inch diameter and larger, the nominal inside diameter after lining shall be not less than the indicated diameter, allowing for tolerances according to AWWA C200 and C205.

3. Pipe, specials, and fittings smaller than 14-inch diameter may be furnished in standard outside diameters.

4. When indicated as a minimum, wall thickness tolerance shall be as allowed by AWWA C200 or the ASTM nominal sheet or plate tolerance, whichever is less.

B. Markings

1. The manufacturer shall legibly mark pipe, specials, and fittings in accordance with the laying schedule and marking diagram.

2. Each pipe, special, and fitting shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation.

3. Each pipe, fitting, and special shall be marked at each end with top field centerline.

C. Handling and Storage

1. The pipe, specials, and fittings shall be handled by use of wide slings, padded cradles, or other devices designed and constructed to prevent damage to the pipe coating and exterior.

2. The use of chains, hooks, or other equipment that might injure the pipe coating or exterior will not be permitted.

3. Stockpiled pipe, specials, and fittings shall be supported on padded skids, sand or earth berms free of rock exceeding 3 inches in diameter, sand bags, or suitable means so that the pipe including coating and lining coating will not be damaged.

4. Pipe, specials, and fittings shall not be rolled and shall be secured to prevent accidental rolling.

D. The CONTRACTOR shall replace or repair damaged pipe, specials, and fittings.

E. Strutting

1. Adequate strutting shall be provided on specials, fittings, and straight pipe in order to avoid damage to the pipe, specials, and fittings during handling, storage, hauling, and installation.

2. For mortar-lined steel pipe, specials, or fittings the following requirements shall apply:

    a. The strutting shall be placed as soon as practicable after the mortar lining has been applied and shall remain in place while the pipe, special, or fitting is loaded, transported, unloaded, installed, and backfilled at the Site.

    b. The strutting materials, size, and spacing shall be adequate to support the earth backfill plus any greater loads that may be imposed by the backfilling and compaction equipment.

    c. Any pipe, special, or fitting damaged during handling, hauling, storage, or installation due to improper strutting shall be repaired or replaced.

F. Laying Length

1. The maximum pipe laying length shall be 48 feet, with shorter lengths to be provided as indicated and required.

G. Lining

1. The pipe, specials, and fittings shall have smooth, dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.

H. Closures and Correction Pieces

1. Closures and correction pieces shall be provided as required such that closures may be made due to different headings in the pipe laying operation and such that corrections may be made to adjust the pipe laying to conform to the indicated pipe stationing.

2.2 MATERIALS

A. Mortar Lining and other approved Lining

1. Materials for mortar shall conform to the requirements of AWWA C205; provided that cement for mortar coating shall be Type II. Pipe lining shall be fusion bonded epoxy on pump suction piping and cement mortar on pump discharge piping. Refer to Section 09 96 00, Protective Coatings for more information.

2. Cement in mortar lining and coating shall not originate from kilns that burn metal-rich hazardous waste fuel, nor shall a fly ash or pozzolan be used as a cement replacement.

3. Admixtures shall contain no calcium chloride.

B. Steel for Cylinder and Fittings

1. Pipe, specials, and fittings manufactured under AWWA C200 shall satisfy the following requirements:

    a. minimum yield strength of steel: 42,000 psi

    b. manufactured by a continuous casting process

c. fully kilned

d. fine grain practice

e. maximum carbon content: 0.25 percent

f. maximum sulfur content: 0.015 percent

g. minimum elongation: 22 percent in a 2-inch gauge length

h. in accordance with one of the following Standards:

1) ASTM A 1011 - Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

2) ASTM A 283 - Low and Intermediate Tensile Strength Carbon Steel Plates

3) ASTM A 572 - High Strength Low-Alloy Columbium-Vanadium Structural Steel

4) ASTM A 1018 - Steel, Sheet and Strip, Heavy Thickness Coils, Hot-Rolled Carbon, Structural, High-Strength Low-Alloy Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability

2. Testing

a. Steel equal to or greater than 1/2 inch thick used in fabricating pipe shall be tested for notch toughness using the Charpy V-Notch test in accordance with ASTM A 370 - Test Methods and Definitions for Mechanical Testing of Steel Products.

b. The frequency of testing shall be one impact test (set of 3 specimens - transverse, not longitudinal) for each coil used in manufacturing the pipe.

c. The testing frequency for sheets and plates shall be one impact test (set of 3 specimens) for each 200 tons of product.

d. The steel shall withstand a minimum impact of 25 ft-lb at a temperature of 30 degrees F.

2.3 DESIGN OF PIPE

A. General

1. The pipe shall be suitable to transmit raw sewage under the indicated conditions.

2. The steel pipe shall have field-welded joints as indicated.

3. The pipe shall consist of a steel cylinder, shop-lined with cement mortar lining in accordance with AWWA C205 and an exterior shop coating compatible with finish coating required by 09 96 00.

B. The pipe shall be designed, manufactured, tested, inspected, and marked according to applicable requirements as indicated and, except as indicated, shall conform to AWWA C200.

C. Pipe Dimensions

1. The pipe shall be of the diameter and minimum wall thickness indicated.

D. Fitting Dimensions

1. Fittings shall be of the diameter and class indicated.

E. Joint Design

1. Butt-strap joints shall be used only where required for closures or where indicated.

2. Unless indicated otherwise, the standard field joint for steel pipe shall be as indicated in the following table:

Pipe Diameter	Application	Joint Type
60 inches and less	non-restrained areas	rolled gasket joint, Carnegie gasket joint
	non-restrained and restrained areas	lap-welded joint, butt joint
	closures, restrained and non-restrained	butt strap joint

F. Lap Joints for Field Welding

1. Lap joints prepared for field welding shall be in accordance with AWWA C200.

2. The method used to form, shape, and size bell ends shall be such that the physical properties of the steel are not substantially altered.

3. Unless otherwise approved by the ENGINEER, bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape.

4. Faying surfaces of the bell and spigot shall be essentially parallel except for mitered bells, but the bell slope shall not vary more than 2 degrees from the longitudinal axis of the pipe.

5. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions.

6. In the absence of a history of field performance, the results of a test program shall be submitted.

7. Unless otherwise approved by the ENGINEER, bell ends shall be formed by an expanding press or by being moved axially over a die in such a manner as to stretch

the steel plate beyond its elastic limit to form a truly round bell of suitable diameter and shape.

8. No process will be permitted in which the bell is formed by rolling.

9. Spiral weld seams shall be tested by the visible penetrant method of ASTM E 165 - Methods for Liquid Penetrant Inspection, or by the magnetic particle inspection method of ASME Section VIII, Division 1, Appendix VI, for a minimum distance of 12 inches from each end of each joint after the spigot and bell are formed.

10. Defects shall be repaired.

G. Field Joints

1. The joints shall have the same or higher pressure rating as the adjoining pipe.

2. The clearance between faying surfaces shall be less than 1/8 inch.

H. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated or as otherwise acceptable to the ENGINEER.

I. Restrained Joints

1. Restrained joints shall be located where indicated

2. Restrained joints shall be field-welded joints, either single, or inside and outside lap-weld, or butt-weld, or butt-straps as indicated.

3. Designs shall include stresses created by the greater of:

a. a temperature differential of 40 degrees F plus Poisson's effect in combination with hoop stress, or;

b. thrust due to bulkheads, bends, reducers, and line valves resulting from working pressure in combination with hoop stress.

4. For field-welded joints, design stresses shall not exceed 50 percent of the specified minimum yield strength of the grade of steel utilized, or 21,000 psi, whichever is less, for the part being examined when longitudinal thrust is assumed to be uniformly distributed around the circumference of the joint

2.4 SPECIALS AND FITTINGS

A. Design

1. Except as otherwise indicated, materials, fabrication and shop testing of specials and fittings shall conform to the requirements stated above for pipe and shall conform to the dimensions of AWWA C208.

2. The minimum thickness of plate for pipe from which specials are to be fabricated shall be the greatest of those determined by the following 3 criteria:

a. Working and Transient Pressure Design

$$T = \frac{P_w D/2}{Y/S_w} \qquad T = \frac{P_t D/2}{Y/S_t}$$

Where:

T	=	Steel cylinder thickness in inches
D	=	Outside diameter of steel cylinder in inches
P_w	=	Design working pressure in psi
P_t	=	Design transient pressure in psi
Y	=	Specified minimum yield point of steel in psi
S_w	=	Safety factor of 2.5 at design working pressure
S_t	=	Safety factor at design transient pressure; for elbows 1.875 and 2.0 for other specials

b. Mainline Pipe Thickness: Plate thickness for specials shall be not less than the adjacent mainline pipe.

c. Thickness Based on Pipe Diameter

Nominal Pipe Diameter, inches	Pipe Manifolds Piping Above Ground Piping Structures
24 and under	1/4 inch

B. Specials

1. Specials installed on saddle supports shall be designed to limit the longitudinal bending stress to a maximum of 10,000 psi.

2. Design shall be in accordance with the provisions of Chapter 7 of AWWA Manual M11.

C. Deflections and Angles

1. Moderate deflections and long radius curves may be constructed by means of beveled joint rings, by pulling standard joints, by using short lengths or pipe, or a combination of these methods provided that pulled joints shall not be used in combination with bevels.

2. The maximum total allowable angle for beveled joints shall be 5 degrees per pipe joint.

3. Bevels shall be provided on the bell ends.

4. Mitering of the spigot ends will not be accepted.

5. The maximum allowable angle for pulled joints shall be in accordance with the manufacturer's recommendations, or the angle which results from a 3/4-inch pull-out from normal joint closure, whichever is less.

6. Horizontal deflections or fabricated angles shall fall on the alignment.

7. Vertical Deflections

a. Vertical deflections shall fall on the alignment and shall be at locations adjacent to underground obstructions, points of minimum earth cover, and pipeline outlets and structures.

b. The pipe angle points shall match the indicated angle points.

D. Outlets, Tees, Wyes, Crosses, and Nozzles

1. Outlets 12 inches and smaller may be fabricated from Schedule 30 or heavier steel pipe in the standard outside diameters, that is, 12-3/4-inch, 10-3/4-inch, 8-5/8-inch, 6-5/8-inch, and 4-1/2-inch.

2. The minimum plate thickness for reinforcements shall be 10-gauge.

3. The outlet reinforcement design shall be in accordance with the procedures given in Chapter 13 of AWWA Manual M11, and the design pressures and factors of safety indicated above.

4. In lieu of saddle or wrapper reinforcement as provided by the design procedure in Manual M11, pipe or specials with outlets may be fabricated entirely of steel plate having a thickness equal to the sum of the pipe wall plus the required reinforcement.

5. Where Manual M11 requires the design procedure for crotch plate reinforcement, such reinforcement shall be provided.

6. Reinforcing Plates

a. Outlets shall be fabricated such that there is always at least a 12-inch distance between the outer edge of the reinforcing plate and any field-welded joints.

b. For outlets without reinforcing plates, outlets shall penetrate the steel cylinders so that there is at least a 12-inch clearance between the outlet and any field-welded joints.

7. Tees, wyes, crosses, elbows, and manifolds shall be fabricated such that the outlet clearances and reinforcing plates from any weld joints are a minimum of 5 times cylinder thickness or 2 inches, whichever is greater.

8. Longitudinal weld joints in adjacent cylinder sections shall be oriented such that there is a minimum offset of 5 times cylinder thickness or 2 inches, whichever is greater.

9. Reinforcement

a. Reinforcement for wyes, tees, outlets, and nozzles shall be designed in accordance with AWWA Manual M11.

b. Reinforcement shall be designed for the design pressure indicated and shall be as indicated.

10. Specials and fittings shall be equal in pressure design strength and shall have the same lining and coating as the adjoining pipe.

11. Unless otherwise indicated, the minimum radius of elbows shall be 2.5 times the pipe diameter and the maximum miter angle on each section of the elbow shall not exceed 11-1/4 degrees.

E. Steel welding fittings shall conform to ASTM A 234 - Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

F. Ends for Mechanical-Type Couplings

1. Except as otherwise indicated, where mechanical-type couplings are indicated the ends of pipe shall be banded with Type C collared ends using double fillet welds.

2. Where pipe 12-inch and smaller is furnished in standard schedule thickness and where the wall thickness equals or exceeds the coupling manufacturer's minimum wall thickness, the pipe ends may be grooved.

2.5 FUSION BONDED EPOXY LINING (PUMP SUCTION PIPING)

A. Fusion bonded epoxy lining Lining for Shop Application

1. Where indicated, interior surfaces of pipe, specials, and fittings shall be cleaned and lined in the shop with fusion bonded epoxy lining applied centrifugally in conformity with AWWA 116.

2. During the lining operation and thereafter, the pipe, specials, and fittings shall be maintained in a round condition by suitable bracing or strutting.

3. The lining machines shall be of a type that has been used successfully for similar WORK.

4. Every precaution shall be taken to prevent damage to the lining.

5. If the lining is damaged or found defective at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to the indicated requirements.

B. The minimum lining thickness and tolerance shall be in accordance with AWWA 116 .

C. Field Joints

1. The pipe shall be left bare as indicated where field joints occur.

2. Ends of the linings shall be left square and uniform.

3. Feathered or uneven edges will not be accepted.

D. Defective Linings

1. Defective linings, as determined by the ENGINEER, shall be removed from the pipe wall and shall be replaced to the full thickness required.

2. Defective linings shall be cut back to a square shoulder in order to avoid feather-edged joints.

E. The progress of the application of mortar lining shall be regulated in order that handwork, including the repair of defective areas, is cured in accordance with the provisions of AWWA C205.

F. Cement mortar for patching shall be the same materials as the mortar for machine lining, except that a finer grading of sand and mortar richer in cement shall be used when field inspection indicates that such mix will improve the finished lining of the pipe.

G. Hand-Applied Linings

1. Specials and fittings that cannot be mechanically lined and coated shall be lined and coated by hand-application using the same materials as used for the pipe and in accordance with the applicable AWWA or ASTM standards and as indicated.

2. Coating and lining applied in this manner shall provide protection equal to that for the pipe.

3. Fittings may be fabricated from pipe that has been mechanically lined and/or coated.

4. Areas of lining and coating that have been damaged by such fabrication shall be repaired by hand-application.

H. Cement-Mortar Lining for Field Application -

1. Steel pipe shall be mortar-lined on pump discharge piping. For fusion bonded epoxy lined pump suction piping refer to Section 09 96 00.

2. The materials and design of in-place cement mortar lining shall be in accordance with AWWA C602 and the following supplementary requirements:

a. Pozzolanic material shall not be used in the mortar mix.

b. Admixtures shall contain no calcium chloride.

c. The minimum lining thickness shall be as indicated for shop-applied cement mortar lining, and finished inside diameter after lining shall be as indicated.

d. Temperature and shrinkage cracks in the mortar less than 1/16 inch wide need not be repaired, whereas pipe, specials, or fittings with mortar cracks wider than 1/16 inch shall be rejected.

I. Protection of Pipe Lining/Interior

1. For pipe, specials, and fittings with plant-applied cement-mortar linings, the CONTRACTOR shall provide a 12-mil polyethylene sheet or other suitable bulkhead on the ends of the pipe and on each opening to prevent the lining from drying out.

2. Bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

2.6 EXTERIOR COATING OF PIPE

A. Exterior Coating of Exposed Piping

1. The exterior surfaces of pipe, specials, and fittings that will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of primer compatible with the finish coating required by Section 09 96 00 – Protective Coating.

B. Flexible Coatings

1. Flexible coatings shall conform to AWWA C116 PROTECTIVE FUSION BONDED EPOXY COATINGS

2. The CONTRACTOR shall select one flexible coating system for all piping in the Contract; the use of both systems in any combination will not be accepted.

2.7 PIPE APPURTENANCES

A. Pipe appurtenances shall be in accordance with the requirements as indicated.

B. Access manholes with covers shall be as indicated, installed during fabrication and not in the field.

C. Threaded outlets shall be forged steel suitable for 3000-psi service, and shall be as manufactured by **Vogt**, or equal.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

A. Handling and Storage

1. Pipe, specials, and fittings shall be carefully handled and protected against damage to lining and coating/interior and exterior surfaces, and impact shocks and free fall.

2. Pipe, specials, and fittings shall not be placed directly on rough ground but shall be supported in a manner that will protect the pipe against injury whenever stored at the Site or elsewhere.

3. Pipe, specials, and fittings shall be handled and stored at the Site in accordance with the requirements indicated in Part 2, above.

4. No pipe shall be installed when the lining or coating, or interior or exterior surfaces show cracks that may be harmful as determined by the ENGINEER.

5. Such damaged lining and coating, and interior and exterior surfaces shall be repaired or a new undamaged pipe, special, or fitting shall be provided.

B. Pipe damaged prior to Substantial Completion shall be repaired or replaced.

C. The CONTRACTOR shall inspect each pipe, special, and fitting for damage.

D. The CONTRACTOR shall remove or smooth out any burrs, gouges, weld splatter, or other small defects prior to laying the pipe, special, or fitting.

E. Cleaning

1. Before the placement of pipe, specials, or fittings in the trench, each shall be thoroughly cleaned of any foreign substance that may have collected thereon and shall be kept clean thereafter.

2. For this purpose, the openings of pipes, specials, and fittings in the trench shall be closed during any interruption to the WORK.

F. Placement

1. Pipe, specials, and fittings shall be laid directly on the imported bedding material.

2. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe, special, or fitting.

3. Excavations shall be made as needed to facilitate removal of handling devices after the item has been laid.

4. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings.

5. Excavation outside the normal trench section shall be made at field joints as needed to permit adequate access to the joints for field connection operations and for application of coating on field joints.

6. Except for short runs that may be permitted by the ENGINEER, pipes shall be laid uphill if on grades exceeding 10 percent.

7. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement.

8. Bends shall be installed as indicated.

G. Installation Tolerances

1. Each section of pipe, special, or fitting shall be laid in the order and position on the laying diagram and in accordance with the following:

   a. Each section of pipe, special, or fitting having a nominal diameter less than 48 inches shall be laid to line and grade, within plus or minus 2 inches horizontal deviation and plus or minus one inch vertical deviation.

   b. Each section of pipe, special, or fitting having nominal diameter 48 inches and larger shall be laid to line and grade, within plus or minus 5 percent of diameter horizontal deviation and plus or minus 2.5 percent of diameter vertical deviation.

   c. In addition to the horizontal and vertical tolerances above, the pipe shall be laid so that no high or low points other than those on the laying diagram are introduced.

   d. After installation, the pipe, specials, and fittings shall not show deflection greater than:

      1) mortar-lined and mortar-coated pipe, specials, and fittings: 1.5 percent

      2) mortar-lined and flexible-coated pipe, specials, and fittings: 2.25 percent

      3) flexible-lined and flexible-coated or bare pipe, specials, and fittings: 3.0 percent

   e. The allowable deflection shall be based on the design inside diameter.

H. Test Section

1. At the beginning of pipe laying operations, the CONTRACTOR shall perform a test section to demonstrate that the methods and materials to be used will satisfy the pipe zone backfill compaction and pipe deflection criteria.

2. The maximum length of the test section shall be 500 feet.

3. The CONTRACTOR shall not proceed with production pipe laying beyond the test section without the ENGINEER's approval.

4. The entire test section length that does not comply with the Contract Documents shall be reworked as necessary to comply.

5. The ENGINEER will observe construction of the test section.

6. The OWNER will take measurements and keep records for quality assurance purposes.

7. Any change in means, methods, and trench conditions, including excavation, bedding, and pipe zone materials, in situ soils, water conditions, and backfill and compaction methods shall require another successful test section before additional production pipe installation.

I. Changes in Alignment and/or Grade

1. Where necessary to raise or lower the pipe, specials, or fittings due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grade.

2. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings, although in no case shall the deflection in a joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer.

3. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

4. In each case the joint opening, before finishing with the protective mortar inside the pipe, shall be the controlling factor.

J. Pipe, Specials, and Fitting Protection

1. The openings of pipe, specials, and fittings with shop-applied mortar lining shall be protected with suitable bulkheads to maintain a moist atmosphere and to prevent unauthorized access by persons, animals, water, or any undesirable substance.

2. The bulkheads shall be designed to prevent the drying out of the interior of the pipe, specials, and fittings.

3. The CONTRACTOR shall introduce water into the pipe to keep the mortar moist if moisture has been lost due to damaged bulkheads.

4. Means shall be provided to prevent the pipe from floating due to water in the trench from any source.

5. Pipe that has floated shall be repaired, including restoration to original condition and profile.

K. Pipe Cleanup

1. As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of debris.

2. The CONTRACTOR shall completely clean the interior of the pipe of sand, dirt, mortar splatter, and any other debris following completion of pipe laying, pointing of joints, and any necessary interior repairs prior to testing and disinfecting of the completed pipeline.

3.2 WELDED JOINTS

A. General

1. Prior to beginning the welding procedure, any tack welds used to position the pipe during laying shall be removed.

2. Any annular space between the faying surfaces of the bell and spigot shall be equally distributed around the circumference of the joint by shimming, jacking, or other suitable means.

3. Where more than one pass is required, each pass except the first and final ones shall be peened to relieve shrinkage stresses, and dirt, slag, and flux shall be removed before the succeeding bead is applied.

4. Prior to butt welding, the pipe and joint shall be properly positioned in the trench using line up clamps so that, in the finished joint, the abutting pipe sections shall not be misaligned more than 1/16 inch.

5. Unless double fillet welds are indicated, field welded lap joints may, at the CONTRACTOR'S option, be made on either the inside or the outside of the pipe.

6. Field welded joints shall be in accordance with AWWA C206 - Field Welding of Steel Water Pipe.

7. Where exterior welds are performed, adequate space shall be provided for welding and inspection of the joints.

8. Butt straps shall be as indicated.

9. A heat resistant shield shall be draped over at least 24-inches of coating beyond the holdback on both sides of the weld during welding to avoid damage to the coating by hot weld splatter.

10. Welding grounds shall not be attached to the coated part of the pipe.

B. Inspection of Field-Welded Joints

1. An independent testing laboratory acceptable to the ENGINEER but paid by the CONTRACTOR shall inspect the joints.

2. Inspection shall be as soon as practicable after the welds are completed.

3. Fillet welds shall be tested by the Magnetic Particle Inspection Method in accordance with ASME Section VIII, Division 1, Appendix VI.

4. Double-Welded Lap Joints

    a. Double-welded lap joints shall be air-tested by shop drilling and tapping for 1/8-inch or 1/4-inch national pipe thread in the lap or bell end of the pipe.

    b. Apply 40 psig of air or other satisfactory gas into the connection between the 2 fillet welds.

    c. Test pressure shall be measured with a minimum 4-inch diameter pressure gauge with a range no greater than 0 to 100 psig.

    d. The air test shall consist of holding the test pressure undiminished for 5 minutes.

    e. If the air test fails, paint the welds with a soap solution and mark any leaks indicated by the escaping gas bubbles.

    f. Leaking portions of the welds or defective welds shall be removed and re-welded.

    g. The amount of material removed shall be limited to that required to correct the defect.

    h. After the repair is made, the joint shall be checked by repeating the original test procedure.

    i. Close the threaded openings with pipe plugs or by welding.

5. Butt welds shall be inspected by radiographic methods in accordance with API Standard 1104.

C. Following tests of the joint, the exterior joint spaces shall be coated as indicated, after which backfilling may be completed.

D. Repair of Welds

1. Defective welds shall be repaired by the CONTRACTOR to meet the indicated requirements.

2. Defects in welds or defective welds shall be removed, and that section of the joint shall then be re-welded.

3. Only sufficient removal of defective material that is necessary to correct the defect shall be required.

4. After the repair is made, the joint shall be checked by repeating the original test procedure.

5. Welds deficient in size shall be repaired by adding weld metal.

3.3 JOINT COATING AND LINING

A. General

1. The interior and exterior joint recesses shall be thoroughly wiped clean.

2. Remove water, loose scale, dirt, and other foreign material from the inside surface of the pipe..

B. Testing

1. The ENGINEER will test each joint with an electrical detector, furnished by the CONTRACTOR and capable of at least a 12,000 volt output.

2. The tests will be performed using 6,000 to 7,000 volts.

3. The CONTRACTOR shall repair any holidays.

4. Re-Testing

a. When a visual inspection indicates that a portion of the coating system has sustained physical damage, the CONTRACTOR shall perform an electrical holiday test of 6,000 to 7,000 volts.

b. When the test indicates no holiday, a notation shall be applied to the area indicating the test is satisfactory.

C. Coating Repair

1. Mortar-Coated Pipe: Perform coating repairs on mortar-coated pipe in accordance with the requirements of AWWA C205.

D. Joint Lining

1. After the field welding has been completed to final grade, the interior joint recess shall be filled with mortar.

2. Materials of construction for mortar shall be in accordance with the requirements of AWWA C602.

3. The mortar shall be tightly packed into the joint recess and troweled flush with the interior surface, and excess shall be removed.

4. At no point shall there be an indentation or projection of the mortar exceeding 1/16 inch.

5. The joint shall be completed and excess mortar on the inside of the joint shall be swabbed out.

3.4 INSTALLATION OF PIPE APPURTENANCES

A. Installation of Valves

1. Valves shall be handled in a manner to prevent any injury or damage to the valve or any part of it.

2. Joints shall be thoroughly cleaned and prepared prior to installation.

3. The CONTRACTOR shall adjust stem packing and operate each valve prior to installation to verify proper operation.

4. Valves shall be installed so that the valve stems are plumb and in the location indicated.

B. Installation of Flanged Joints

1. Before the joint is assembled, the flange faces shall be thoroughly cleaned of foreign material with a power wire brush.

2. The gasket shall be centered and the connecting flanges drawn up watertight without unnecessarily stressing the flanges.

3. Bolts shall be tightened in a progressive diametrically opposite sequence and torqued with a suitable and calibrated torque wrench.

4. Clamping torque shall be applied to the nuts only.

5. Full-face reinforced rubber gaskets shall be applied to the inside face of blind flanges with adhesive.

C. Insulated Joints

1. Insulated joints and appurtenant features shall be provided as indicated.

2. The CONTRACTOR shall exercise special care when installing these joints in order to prevent electrical conductivity across the joint.

3. After the insulated joint is completed, an electrical resistance test shall be performed by the CONTRACTOR.

4. If the resistance test indicates a short circuit, the CONTRACTOR shall remove the insulating units to inspect for damage, replace all damaged portions, and reassemble the insulating joint.

5. The insulated joint shall then be retested to assure proper insulation.

D. Flexible Coupled Joints

1. When installing flexible couplings, care shall be taken that the connecting pipe ends, couplings, and gaskets are clean and free of dirt and foreign matter, with special attention given to the contact surfaces of the pipe, gaskets, and couplings.

2. The couplings shall be assembled and installed in conformance with the recommendations and instructions of the coupling manufacturer.

E. Bolting

1. Wrenches used in bolting couplings shall be of a type and size recommended by the coupling manufacturer.

2. Coupling bolts shall be tightened in such a manner as to secure a uniform annular space between the follower rings and the body of the pipe.

3. Bolts shall be tightened approximately the same amount.

4. Diametrically opposite bolts shall be tightened progressively and evenly.

5. Final tightening shall be performed with a suitable and calibrated torque wrench set for the torque recommended by the coupling manufacturer.

6. Clamping torque shall be applied to the nut only.

END OF SECTION

SECTION 33 92 20 - DUCTILE IRON PIPING

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide ductile iron pipe and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 in through 48 in for Water
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C116	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast for Water
AWWA C153	Ductile-Iron Compact Fittings. for Water Service
AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances
AWWA C606	Grooved and Shouldered Joints
ASTM C 150	Portland Cement

1.3 CONTRACTOR SUBMITTALS

A. Furnish Submittals in accordance with Section 01 33 00 - Contractor Submittals and the following supplemental requirements:

B. Shop Drawings

1. Certified dimensional drawings of valves, fittings, and appurtenances.

2. For pipe 24-inches diameter and larger, line layout and marking diagrams which indicate the specific number of each 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 changes in grade or horizontal alignment; elements of curves

and bends, both in horizontal and vertical alignment; and the limits of each reach of restrained joints, or of concrete encasement.

C. Certifications: Certified affidavit of compliance for pipe and other products or materials furnished under this Section and as specified in the referenced standards and the following supplemental requirements:

1. Physical and chemical properties.

2. Hydrostatic test reports.

D. The CONTRACTOR shall be responsible for performing and paying for sampling and testing as necessary for the certifications.

1.4 QUALITY ASSURANCE

A. Tests: Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

B. The CONTRACTOR shall perform said material tests as part of the WORK. The ENGINEER shall have the right to witness testing conducted by the CONTRACTOR; provided, that the CONTRACTOR's schedule is not delayed for the convenience of the ENGINEER.

C. In addition to those tests specifically required, the ENGINEER may request additional samples of any material including lining and coating samples for testing by the OWNER. The additional samples shall be furnished as a part of the WORK.

D. Inspection: Pipe shall be subject to inspection at the place of manufacture in accordance with the provisions of the referenced standards, as supplemented by the requirements herein. The CONTRACTOR shall notify the ENGINEER in writing of the manufacturing starting date not less than 14 Days prior to the start of any phase of the pipe manufacture.

E. During the manufacture of the pipe, the ENGINEER shall be given access to areas where manufacturing is in process and shall be permitted to make inspections necessary to confirm compliance with the Specifications.

PART 2 -- PRODUCTS

2.1 PIPE GENERAL

A. Mortar-lined and bonded dielectric coated ductile iron pipe shall conform to AWWA C151, and C116**,** subject to the supplemental requirements in this Section. The pipe shall be of the diameter and class indicated, shall be provided complete with rubber gaskets, specials, and fittings as required under the Contract Documents.

B. Markings: The CONTRACTOR shall legibly mark specials 24-inches diameter and larger in accordance with the laying schedule and marking diagram. Each fitting shall be marked at each end with top field centerline.

C. Handling and Storage: The pipe shall be handled as a minimum at the 1/3 points by use of wide slings, padded cradles, or other devices designed and constructed to prevent

damage to the pipe coating/exterior. The use of chains, hooks, or other equipment that might injure the pipe coating/exterior will not be permitted. Stockpiled pipe shall be supported on padded skids, sand or earth berms free of rock exceeding 3-inches diameter, sand bags, or suitable means so that the coating will not be damaged. The pipe shall not be rolled and shall be secured to prevent accidental rolling

D. Bonded dielectric-coated pipe shall have the following additional requirements:

1. It shall be the responsibility of the CONTRACTOR to prevent damage of the coating that might be caused by handling and/or storage of the completed pipe at low temperature.

E. Laying Lengths: Nominal pipe laying lengths shall be 20-feet.

F. Finish: The pipe shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing, and roughness.

G. Bonding and Electrical Conductivity: Pipe joints shall be prepared for bonding for electrical conductivity in accordance with the details indicated. The CONTRACTOR shall furnish materials required for joint bonding and electrolysis test station installations.

H. Closures and Correction Pieces: Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing on the Drawings. The locations of correction pieces and closure assemblies are indicated. Any change in location or number of said items shall only be as accepted by the ENGINEER.

2.2 SPECIALS AND FITTINGS

A. Fittings for ductile iron pipe shall conform to the requirements of AWWA C153 or AWWA C110 and shall have a minimum pressure rating of 250 psi. Ductile iron fittings larger than 48-inches shall conform to AWWA C153.

2.3 DESIGN OF PIPE

A. The pipe shall be designed, manufactured, tested, inspected, and marked according to AWWA C150 and C 151 except where modified by this Section.

B. Pipe Dimensions: The pipe shall be of the diameter and class indicated.

C. Fitting Dimensions: The fittings shall be of the diameter and class indicated.

D. Joint Design: Ductile iron pipe and fittings for buried pressure service shall be furnished with restrained joints, unless otherwise indicated. Ductile iron pipe and fittings for buried gravity service shall be furnished with mechanical joints or push-on joints as required, unless otherwise indicated. Above ground ductile iron pipe and fittings joints shall be as indicated. Flanged joints or grooved and shouldered joints shall be furnished where required.

1. Mechanical and push-on joints shall conform to AWWA C111.

2. Flanged joints shall conform to AWWA C115. Where threaded flanges are provided, the pipe wall thickness under the cut threads shall not be less than the calculated net thickness required for the pressure class of the pipe.

3. Restrained joints shall be **Flex-Ring or Lok-Ring** restrained joint by **American Ductile Iron Pipe**, **TR FLEX** or HP Lok restrained joint by **U.S. Pipe**, or equal.

4. Joint restraining devices that impart point loads and/or wedging action on the pipe wall as a means of joint restraint shall not be allowed unless there are no other options for joint restraint available. Under such circumstances, the CONTRACTOR may propose such devices provided the following conditions are met and the request is made as a substitution:

   a. A formal request for substitution is submitted stating the locations where the devices are intended to be used and a statement from the device manufacturer and the pipe manufacturer that the proposed device is appropriate for the intended installation and is rated at least for the class of the pipe being supplied.

   b. A statement from the pipe manufacturer is provided accepting the use of the retaining devices and indicating that the use of such devices will in no way affect the warranty of the pipe and/or the performance of the pipe.

   c. The manufacturer of the device and the pipe manufacturer jointly provide instruction on the proper installation of the device to the personnel installing the units and provide certification to the OWNER that the installers are adequately trained in the installation of the units and that warranties are in full affect for the project.

   d. The devices shall be **MegaLug Model 1100** as manufactured by **EBAA Iron** or equal.

5. Grooved and Shouldered Joints shall meet the requirements of mechanical-type couplings in accordance with Section 43 10 50 – Piping, General and conform to AWWA C606.

E. For bell-and-spigot ends with rubber gaskets, the clearance between the bells and spigots shall be such that when combined with the gasket groove configuration and the gasket itself, will provide watertight joints under all operating conditions when properly installed. The CONTRACTOR shall require the pipe manufacturer to submit details complete with significant dimensions and tolerances and also to submit performance data indicating that the proposed joint has performed satisfactorily under similar conditions. In the absence of a history of field performance, the results of a test program shall be submitted.

2.4 LINING – FUSION BONDED EPOXY

A. Fusion Bonded Eposy Lining for Shop Application: Where indicated, interior surfaces of ductile iron pipe, fittings, and specials shall be cleaned and lined in the shop with fusion bonded epoxy in conformity with AWWA C116 and Section 099600. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found defective at the Site, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications.

2.5 EXTERIOR PROTECTION OF PIPE

A. Exterior Coating of Exposed Piping: The exterior surfaces of pipe which will be exposed to the atmosphere inside structures or above ground shall be thoroughly cleaned and then given a shop coat of rust-inhibitive primer conforming to the requirements of Section 09 96 00- Protective Coating.

B. Exterior Coating of Buried Piping: The exterior coating shall be an asphaltic coating approximately 1-mil thick.

PART 3 -- EXECUTION

3.1 INSTALLATION OF PIPE

A. The CONTRACTOR shall inspect each pipe and fitting prior to installation to insure that there are no damaged portions of the pipe. Pipe damaged prior to Substantial Completion shall be repaired or replaced by the CONTRACTOR.

B. Before placement of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of any foreign substance which may have collected thereon and shall be kept clean at all times thereafter. For this purpose, the openings of pipes and fittings in the trench shall be closed during any interruption to the WORK.

C. Pipe Laying: The pipe shall be installed in accordance with AWWA C600.

D. Pipe shall be laid directly on the bedding material. No blocking will be permitted, and the bedding shall be such that it forms a continuous, solid bearing for the full length of the pipe. Excavations shall be made as needed to facilitate removal of handling devices after the pipe is laid. Bell holes shall be formed at the ends of the pipe to prevent point loading at the bells or couplings. Excavation shall be made as needed outside the normal trench section at field joints to permit adequate access to the joints for field connection operations and for application of coating on field joints.

E. Each section of pipe 24-inches diameter and larger shall be laid in the order and position shown on the laying schedule. Each section shall be laid to the line and grade, within approximately one-inch plus or minus.

F. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the ENGINEER may change the alignment and/or the grades. Such change shall be made by the deflection of joints, by the use of bevel adapters, or by the use of additional fittings. However, in no case shall the deflection in the joint exceed 75 percent of the maximum deflection recommended by the pipe manufacturer. No joint shall be misfit any amount that will be detrimental to the strength and water tightness of the finished joint.

G. Except for short runs that may be permitted by the ENGINEER, pipes shall be laid uphill on grades exceeding 10 percent. Pipe that is laid on a downhill grade shall be blocked and held in place until sufficient support is furnished by the following pipe to prevent movement. Bends shall be properly installed as indicated.

H. Cold Weather Protection: No pipe shall be installed upon a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation before backfilling occurs.

I. Pipe and Specials Protection: The openings of pipe and specials shall be protected with suitable bulkheads to prevent unauthorized access by persons, animals, water, or any undesirable substance. At all times, means shall be provided to prevent the pipe from floating.

J. Pipe Cleanup: As pipe laying progresses, the CONTRACTOR shall keep the pipe interior free of debris. The CONTRACTOR shall completely clean the interior of the pipe of sand, dirt, mortar splatter, and any other debris following completion of pipe laying and shall perform any necessary interior repairs prior to testing and disinfecting the completed pipeline.

3.2 RUBBER GASKETED JOINTS

A. Rubber Gasketed Joints: Immediately before jointing pipe, the bell end of the pipe shall be thoroughly cleaned, and a clean rubber gasket shall be placed in the bell groove. The spigot end of the pipe and the inside surface of the gasket shall be carefully cleaned and lubricated. The lubricant shall be suitable for lubricating the parts of the joint for assembly and be a compound listed as in compliance with NSF Standard 61. The lubricant shall be nontoxic, shall not support the growth of bacteria, and shall have no deleterious effects on the gasket material. The lubricant shall not impart taste or odor to water in the pipe. The spigot end of the pipe section shall then be inserted into the bell of the previously laid joint and telescoped into its proper position. Tilting of the pipe to insert the spigot into the bell will not be permitted.

3.3 INSTALLATION OF PIPE APPURTENANCES

A. Protection of Appurtenances: Where the joining pipe is dielectric-coated, buried appurtenances shall be coated in kind. Where pipe is encased in polyethylene sleeves, buried appurtenances shall be encased in polyethylene.

B. Installation of Valves: Valves shall be handled in a manner to prevent any injury or damage to any part of the valve. Joints shall be thoroughly cleaned and prepared prior to installation. The CONTRACTOR shall adjust stem packing and operate each valve prior to installation to insure proper operation.

C. Valves shall be installed so that the valve stems are plumb and in the location indicated.

END OF SECTION

SECTION 40 05 00 - PIPING, GENERAL

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide piping systems indicated, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to piping in Divisions 33 and 40, and on the Drawings and as indicated in the Piping Schedule.

C. The Drawings define the general layout, configuration, routing, method of support, pipe size, and pipe type. The Drawings are not pipe construction or fabrication drawings. The CONTRACTOR shall prepare pipe spooling and fabrication drawings and shall submit them to the ENGINEER for review.

D. Where pipe layout details are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to develop the details necessary to design and construct piping systems to accommodate the specific equipment provided, and to provide spacers, adapters, and connectors for a complete and functional system.

1.2 DEFINITIONS

A. Pipe, piping, pipe work, pipe system, piping system, or similar words, singular or plural shall mean and include, any type of pipes, tubes, fittings, valves, piping specialties, appurtenances, supports, restraints, anchors, coatings and linings and items related to piping.

B. Submerged piping, underwater piping or similar words, shall include any piping located two feet above water surface in basins or tanks

C. Corrosive service shall mean and include in locations listed below:

a. Buried locations

b. Submerged locations or submerged piping.

c. Inside buried vaults, manholes, and structures that do not drain through a gravity sewer or to a sump with a pump.

d. Chemical handling areas

e. Inside trenches, containment walls, and curbed areas

f. Locations indicated or designated in the contract documents.

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Drawings: Layout drawings including necessary dimensions, details, pipe joints, fittings, specials, bolts and nuts, gaskets, valves, appurtenances, anchors, guides,

and material lists. Pipe spooling and fabrication drawings shall indicate spacers, adapters, connectors, fittings, and pipe supports to accommodate the equipment and valves in a complete and functional system.

2. Welding Qualifications and Procedures

3. Pipe Supports: Submit pipe support fabrication drawings including calculations in accordance with Section 40 05 07 - Pipe Supports.

4. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and shall be specifically identified with the applicable style or series designation, and restraint system if applicable.

5. Thermoplastic Pipe Joints: Submit solvent cement manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

6. Gasket Material: Submit gasket manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

7. Seals and Seating Materials: Submit elastomer material and manufacturer's catalog indicating that the recommended product is suitable for each fluid service application.

8. Modular Seals for Pipe: Manufacturer's catalog sheet showing materials and installation procedures.

9. Expansion Joints: Submit detailed calculations and manufacturer's Shop Drawings of proposed expansion joints, piping layouts, and anchors and guides, including information on materials, temperature, and pressure ratings

10. Flexible Connectors: Submit pressure and thermal expansion calculations

C. Samples

1. Performing and paying for sampling and testing as necessary for certifications are the CONTRACTOR'S responsibility.

D. Certifications

1. Necessary certificates, test reports, and affidavits of compliance shall be obtained by the CONTRACTOR.

2. A certification from the pipe fabricator that each pipe will be manufactured subject to the fabricator’s or a recognized Quality Control Program. An outline of the program shall be submitted to the ENGINEER for review prior to the manufacture of any pipe.

1.4 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact.

B. Defective or damaged materials shall be replaced with new materials.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Extent of Work

1. Pipes, fittings, and appurtenances shall be provided in accordance with the requirements of the applicable Sections of Divisions 33 and 40 and as indicated.

2. Materials in contact with potable water or process water that be deemed potable after treatment processes shall be listed as compliant with NSF Standard 61.

B. Piping Supports

1. Pipes shall be adequately supported, restrained, and anchored in accordance with Section 40 05 07 – Pipe Supports, and as indicated.

2. Pump and piping support seismic and wind loads shall be sized in accordance with the design criteria as shown on D-501 – Details.

C. Lining

1. Application, thickness, and curing of pipe lining shall be in accordance with the applicable Sections of Division 33, unless otherwise indicated.

D. Coating

1. Application, thickness, and curing of coating on buried pipe shall be in accordance with the applicable Sections of Division 33 and Section 09 96 00 - Protective Coating, unless otherwise indicated.

2. Pipes above ground or in structures shall be coated in accordance with Section 09 96 00 – Protective Coating.

E. Pressure Rating

1. Piping systems shall be designed for the pressure as defined in respective pipe sections, or as indicated on the Piping Schedule, whichever is greater.

F. Inspection

1. Pipe shall be subject to inspection at the place of manufacture.

2. During the manufacture, the ENGINEER shall be given access to areas where manufacturing is in progress and shall be permitted to make inspections necessary to confirm compliance with requirements.

G. Tests

1. Except where otherwise indicated, materials used in the manufacture of the pipe shall be tested in accordance with the applicable specifications and standards.

2. Welds shall be tested as indicated.

3. The CONTRACTOR shall be responsible for performing material tests.

H. Welding Requirements

1. Qualification of welding procedures used to fabricate pipe shall be in accordance with the provisions of AWS D1.1 - Structural Welding Code or the ASME Boiler and Pressure Vessel Code, Section 9, whichever is applicable.

I. Welder Qualifications

1. Welding shall be performed by skilled welders and welding operators who have adequate experience in the methods and materials to be used.

2. Welders shall be qualified under the provisions of AWS D1.1 or the ASME Boiler and Pressure Vessel Code, Section 9, whichever is applicable.

3. Machines and electrodes similar to those used in the WORK shall be used in qualification tests.

4. Qualification testing of welders and materials used during testing is part of the WORK.

2.2 PIPE FLANGES

A. General

1. Flanges shall be provided with flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise indicated.

2. Flange faces shall be perpendicular to the axis of the adjoining pipe.

3. Flanges for miscellaneous small diameter pipes shall be in accordance with the standards indicated for those pipes.

B. Pressure Ratings

1. 150 psig or less: Flanges shall conform to either AWWA C207 - Steel Pipe Flanges for Waterworks Service--Sizes 4 In. Through 144 In., Class D, or ASME B16.5 - Pipe Flanges and Flanged Fittings, Class 150.

2. Selection Based on Test Pressure

a. Do not expose AWWA flanges to test pressures greater than 125 percent of rated capacity.

b. For higher test pressures, the next higher rated AWWA flange or an ANSI-rated flange shall be selected.

C. Blind Flanges

1. Provide blind flanges in accordance with AWWA C207, or as indicated for miscellaneous small pipes.

2. Blind flanges for pipe diameters 12 inches and greater shall be provided with lifting eyes in the form of welded or threaded eye bolts.

D. Flange Coating

1. Machined faces of metal blind flanges and pipe flanges shall be coated with a temporary rust-inhibitive coating to protect the metal until the installation is completed.

E. Flange Fasteners

1. Unless otherwise shown on the drawings, or indicated in the applicable Sections of Divisions 33 and 40, Bolts and nuts shall conform to the following requirements;

   a. Threads shall be in accordance with ANSI/ASME B1.1, Class 2, UNC for bolt diameters 1” and smaller and UN8 for bolt diameters greater than 1”.

   b. Bolts shall have heavy hexagon heads and heavy hexagon nuts. Length of studs shall provide a projection of not less than 0.25 inch and no more than 0.5 inch through the nut when it is drawn tight.

   c. Thread studs on flange connections are not permitted except where space restrictions preclude the use of standard bolts and where approved by the ENGINEER.

   d. Through bolt holes shall be drilled in accordance with the applicable flange standard.

   e. All bolts fastening metallic flanges shall be provided with plain washers installed under the nut. Washer materials shall be of the same material as the bolt. If the through bolt holes are drilled larger than the applicable standard by 1/8 inch in diameter or more, bolts shall be also installed with a plain washer under the bolt head as well.

   f. All bolts fastening non-metallic flanges shall be provided with plain washers installed under both the bolt head and nut.

   g. Washer materials shall be of the same material as the bolt.

   h. Anti-seize compound shall be used on carbon steel fasteners, and shall be Husk-ITT, Husky 2000; or equal.

   i. Anti-galling compound used for stainless steel fasteners for other services shall be certified for potable water use and shall be Husk-ITT, Lube O’seal; Hercules, Real-Tuff; La Co, Slic-Tite; or equal.

2. Fastener Material Group Numbering System

   a. Flange fasteners shall conform to the following material standards and shall be categorized within the Fastener Material Schedule Groups as indicated:

      1) Material Group C1 (Carbon steel): ASTM A307 Grade B bolts, ASTM A563 Grade B nuts with ASTM F436 washers

      2) Material Group C2 (Carbon steel): ASTM A193 Grade B7 bolts, ASTM A194 Grade 2H nuts with ASTM F436 washers

      3) Material Group S1 (316 SS): ASTM A193, Grade B8M bolts, ASTM A194 Grade 8M nuts with Type 316 SS plain washers.

3. Fastener Material Group Numbers used in Non-Corrosive Service Applications

    a. AWWA C115 ductile iron flanges - Material Group C1

    b. AWWA C207 steel flanges - Material Group C2

    c. ASME B31 group piping flanges – Material Group C2

    d. Non-metallic pipe flanges - Material Group S1

    e. Stainless steel pipe flanges and all others not listed above - Material Group S1

    f. Where mating flanges are of different flange material standards and the specified Fastener Material Groups are in conflict, then fasteners of the higher grade shall be utilized unless otherwise indicated. For the purpose of this requirement, the Material Groups in order of decreasing grade shall be S1, C2, C1. Provide insulating flange sets for dissimilar metal flanged piping to electrically isolate the dissimilar piping.

    g. Where gaskets of Teflon or Viton-A are required, fasteners of Material Group C2 shall be utilized for all C1 flange standards.

4. Fastener Material Group Numbers used in Corrosive Service Applications

    a. All Flange fasteners shall be of Material Group S1 unless S2 and S3 are otherwise indicated on the drawings.

F. Insulating Flanges

1. Insulated flanges shall be provided with bolt holes 1/4-inch diameter greater than the bolt diameter.

G. Insulating Flange Sets

1. In order to prevent corrosion, insulating flange sets shall be furnished on all piping connections where two dissimilar metals are to be connected. Each insulating flange set shall consist of an insulating gasket, insulating sleeves and washers, and a steel washer.

2. For bolt diameters 1-1/2 inches or smaller, insulating sleeves and washers shall be one piece and shall be made of acetyl resin.

3. For bolt diameters larger than 1-1/2 inches, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic material.

4. Insulating flange sets materials used for fluids other than general water and wastewater shall be made of materials compatible with the fluid services.

5. Insulating gaskets shall be full-face.

H. Insulating Flange Manufacturer, or Equal

1. **JM Red Devil, Type E**

2. **Fluid Sealing Products, Inc.**

3. **Enpro Industries, Inc. (GPT)**

I. Flange Gaskets

1. Gaskets for flanged joints used in general water and wastewater service shall be full faced type in accordance with AWWA C207, suitable for temperatures to 700 degrees F, a pH of one to 11, and pressures to 1000 psig.

2. Blind flanges shall be provided with gaskets covering the entire inside face of the blind flange and shall be cemented to the blind flange.

3. Ring gaskets will not be accepted unless otherwise indicated.

4. Unless otherwise indicated, flange gaskets up to 150 psi shall be EPDM sheet material, NSF 61 approved, **Garlock, Style 98206-U (unbranded), or similar products from John Crane, or equal**.

5. Gaskets for flanged joints in PVC and CPVC piping used in general water and wastewater service shall be NSF 61 approved, full-faced, 1/8-inch thick, and made of fluoroelastomer having a durometer hardness of 50 to 70. Gaskets for pipe sizes up to 24-inch and 150 psi shall be Garlock Style XP or similar products from John Crane, or equal.

6. When the mating flange has a raised face, provide stainless steel flat ring gasket filler between the PVC flange and gasket and the adjacent flange.

7. Gaskets for flanged joints used in chemicals, hot air, chlorine and other fluids shall be made of materials compatible with the service, pressure, and temperature. Consult gasket Manufacturer for recommended gasket material.

2.3 PIPE THREADS

A. Pipe threads shall be in conformance with ASME B1.20.1 - Pipe Threads, General Purpose (inch), and be made up with Teflon tape unless otherwise indicated.

B. Unless otherwise indicated, use metal FNPT and plastic MNPT for threaded pipe connections between metal and plastic pipes.

2.4 THREADED INSULATING CONNECTIONS

A. General

1. Threaded insulating bushings, unions, or couplings, as appropriate, shall be furnished for joining threaded pipes of dissimilar metals and for piping systems where corrosion control and cathodic protection are involved.

B. Materials

1. Threaded insulating connections shall be constructed of nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials, and shall have ratings and properties to suit the service and loading conditions.

2.5 MODULAR MECHANICAL SEALS FOR PIPING PENETRATIONS

A. Where indicated and where required in order to prevent flow of water or air, the passages of piping through wall sleeves and cored openings shall be sealed with modular interlocking link mechanical closures.

B. Individual links shall be constructed of EPDM rubber, be suitable for temperatures between minus 40 and plus 250 degrees F, and be shaped to fill the annular space between the outside of the pipe and the inside of the wall sleeve or cored opening.

C. Assemble the links using Type 316 stainless steel bolts and nuts to form a continuous rubber belt around the pipe.

D. Pressure plates under each bolt and nut shall be fabricated of a corrosion-resistant composite material.

E. After the seal assembly is positioned in the sleeve, tighten the bolts against the pressure plates to expand the rubber links and form the watertight seal.

F. Sizing and installation of sleeves and assemblies shall be in accordance with the manufacturer's recommendations.

G. Modular Mechanical Seals Manufacturer, or Equal

1. **EnPro Industries Company (GPT), Link-Seal**

2. **Proco Products, Inc., Pen-Seal**

PART 3 -- EXECUTION

3.1 GENERAL

A. This section specifies the general installation requirements for piping, valves, and related items and shall be installed in accordance with the manufacturer's technical data and printed instructions. Specific piping materials, systems, appurtenances, and related installation and testing requirements are specified in related sections of Divisions 01, 33, and 40, and as noted on the Drawings, Pipe and Valve Schedules.

B. Piping shall be installed in a neat and workmanlike manner, properly aligned and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.

C. CONTRACTOR shall obtain the assistance of the pipe manufacturer to instruct the pipe fitters in the correct installation and support of the piping system. Valves and flanges attached to the pipe shall be provided with adequate supports.

D. Lined Piping Systems

1. The lining manufacturer shall take full responsibility for the complete, final product and its application.

2. Pipe ends and joints of lined pipes at threaded flanges shall be epoxy-coated in order to assure continuous protection.

3.2 INSTALLATION

A. Installation shall be free from defects. Prior to installation, each pipe length shall be carefully inspected, be flushed clean of any debris or dust, and be straightened if not true straight. Ends of threaded pipes shall be reamed and filed smooth. Groove ends shall be clean and free from indentations, projections, and roll marks in the area from the pipe end to the groove. Fittings shall be equally cleaned before assembly.

B. Supports and Anchors: Piping supports, thrust, and seismic restraints shall be provided where shown on the Drawing or where determined to be required in according to Section 40 05 07 - Pipe Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature differences. Pipe shall be firmly supported with fabricated or commercial hangers or supports.

C. Piping Joints: Pipe joints requirements shall conform to the applicable piping sections of Division 33 and Division 40.

1. Threaded Joints: Pipe threads shall be full and cleanly cut with sharp dies. Not more than 3 threads shall remain exposed after installation.

2. Welded Joints: Welded joints shall conform to the specifications and recommendations of ASME B 31.1 - Power Piping. Welding shall be done by skilled and qualified welders. Pipe surface residues, oxides, and heat stains are to be removed from a field weld and the affected areas adjacent by the use of stainless steel wire brushes. For alloy and stainless steel pipe, the post welding surfaces shall be cleaned with a pickle agent such as nitric/hydrofluoric acid solutions or pickle paste or equal, then complete removal of the agent by wash the surface thoroughly with clean water.

3. Flange Joints: Flanged joints shall be made with gaskets with bolts and nuts as specified. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

4. Fusion-Welded Joints: Fusion-welded joints shall be made with the manufacturer's recommended equipment on clean, dry pipe ends. The joints shall be made up at the recommended ambient temperatures, to the pipe manufacturer's written recommendations. The pipe supplier shall be consulted to obtain machinery and expertise for the joining by fusion welded of pipe and fittings. No pipe or fittings shall be joined by fusion by any of the Contractor's personnel unless they are adequately trained and qualified in the techniques involved. Butt fusion joining shall yield a joint strength equal to or greater than the tensile strength of the pipe. Socket fusion, extrusion welding and hot gas welding shall not be used for field connections.

5. Brazed and Soldered Joints: Brazed and soldered joints shall conform to the manufacturer’s recommendations and to the specifications and recommendations of ASME B 31.1 - Power Piping. Brazing shall be done by skilled and qualified welders. Prior to the application of flux, the ends of tubes shall be thoroughly dried and cleaned

6. Grooved Joints: Grooves for grooved couplings and fittings shall be made with specially designed grooving tools to the manufacturer's recommendations and conform to AWWA C 606 – Joints, Grooved and Shouldered Type. Grooves shall

be clean and sharp without flaws, and the pipe ends shall be accurately cut at 90 degrees to the pipe axis.

7. Solvent-Welded Joints: Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, to the pipe or cement manufacturer's written recommendations. PVC socket connections shall be joined with PVC cement conforming to ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC). CPVC socket connections shall be joined with CPVC solvent cement conforming to ASTM F493. For chemical service applications, solvent cement shall be formulated and labeled for use on that chemical.

8. Adhesive Joints: Adhesive joints shall be made with freshly-mixed 2-part epoxy on clean, dry pipe ends per pipe manufacturer recommendations. The joints shall be made up at the recommended ambient temperatures, to the pipe or adhesive manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket.

D. Valves and Unions: Unless otherwise indicated, connections to fixtures, groups of fixtures and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection.

E. Branch Connections: Branch connections in horizontal runs of air and gas piping shall be made from the top of the pipe, to avoid drainage of condensate into the equipment. Unless otherwise indicated for threaded pipe connections between metal and plastic pipes, use metal FNPT and plastic MNPT.

1. Pipe ends and joints of lined pipes at threaded flanges shall be epoxy-coated in order to assure continuous protection.

F. Isolation Joints / Dielectric Protection: Provide electrically isolate connections between dissimilar metal piping connections. Electrical checks shall be made to assure no contact is made between dissimilar metal piping elements.

1. Use dielectric couplings specially designed for the prevention of galvanic reaction between dissimilar metals.

2. For flanged connections, use stainless steel bolts with isolation bushings, washers, and full-face flange gaskets.

G. Core Drilling: Where core drilling is required for pipes passing through existing concrete, core drilling locations shall be determined by radiograph of concrete construction in order to avoid damage to embedded raceways and reinforcing bars.

H. Coating: Exposed pipes shall be coated with a finish coat to the pipe manufacturer's standard protective coating, with the manufacturer's recommended prime coat and a finish coat in accordance with Section 09 96 00 - Protective Coating.

I. Care shall be taken to insure that piping flanges, mechanical-type couplings, sleeve-type couplings, flexible connectors, and expansion joints are properly installed as follows:

1. Gasket surfaces shall be carefully cleaned and inspected prior to making up the connection. Gasket shall be centered properly on the contact surfaces.

2. Connections shall be installed to prevent inducing stress to the piping system or the equipment to which the piping is connected.

3. Contact surfaces for flanges, couplings, and piping ends shall be aligned parallel, concentric, and square to each axis at the piping connections.

4. Flange Bolts

   a. Flange bolts shall be initially hand-tightened with the piping connections properly aligned.

   b. Bolts shall be tightened with a torque wrench in a staggered sequence to the recommended torque for the applicable piping material per AWWA or manufacturer's recommendation. Care shall be taken to avoid over-torquing the bolts especially on plastic flanged joints.

   c. Harness, thrust restraint, and tie rod bolts used for sleeve couplings, flange coupling adapters, or flexible joints shall be tightened gradually and equally at diametrically opposite sides until snug, in order to prevent misalignment and to insure that all studs carry equal loads.

   d. In order to prevent induced stress or misalignment, do not over-torque connections to adjoining pump or equipment. Flanges shall not be deformed nor cracked.

3.3 INSPECTION

A. After completion of the WORK, cuttings, joining and wrapping materials, and other scattered debris shall be removed from the Site. The entire piping system shall be in a clean and functional condition.

B. Inspection: Finished installations shall be carefully inspected for proper joints and supports, interferences, and damage to pipe, fittings, and coating. Temporary plugs and covers shall be removed from openings and floor drains. Defective WORK shall be repaired to the satisfaction of the field engineer or plumbing inspector.

3.4 FIELD TESTING FOR PRESSURE PIPING

A. Prior to enclosure or burying, piping systems shall be pressure tested as required in the Piping Schedule for a period of not less than two hours without exceeding the tolerances listed in the Piping Schedule. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. The CONTRACTOR shall furnish test equipment, labor, materials, and devices as part of the WORK. For additional testing requirements, refer to Section 01 75 00 – Equipment Testing and Pump Station Startup.

B. Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method. Fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines plugged or capped as required during the testing procedures.

C. Leaks shall be repaired, and the system shall be re-tested until no leaks are found.

END OF SECTION

SECTION 40 05 06 – PIPE COUPLINGS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide pipe couplings indicated, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 05 00 - Piping, General apply to the WORK of this Section

C. The provisions of this Section shall apply to piping in Divisions 33 and 40, and on the Drawings.

D. The couplings, adapters and joints shall be provided with restraining devices to restrict pipe axial movement. Where the restraining devices and/or details are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to provide the devices/details necessary to restraint the piping system.

E. The Items specified in this section include the following:

1. Groove Couplings
2. Sleeve Couplings
3. Flanged Coupling Adapters
4. Dismantling Joints
5. Expansion Joints
6. Flexible Connectors
7. Transition Couplings.
8. Quick Disconnect Couplings
9. Tapping Sleeves
10. Miscellaneous Adapters

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.

B. Shop Drawings: Shop Drawings shall contain the following information:

1. Product submittals, and shall be specifically identified with the applicable style or series designation, pressure rating and restraint system if applicable.
2. Couplings schedule or layout indicating where the couplings will be installed.

3. Expansion Joints: Submit detailed calculations and manufacturer's Shop Drawings of proposed expansion joints, piping layouts, and guides, including information on materials, temperature, and pressure ratings

4. Flexible Connectors: Submit pressure and thermal expansion calculations

C. Certifications

1. Necessary certificates, test reports, and affidavits of compliance shall be obtained by the CONTRACTOR.

1.3 MATERIAL DELIVERY, STORAGE, AND PROTECTION

A. Piping couplings, adapters and joints accessories shall be delivered in a clean and undamaged condition and stored off the ground for protection against oxidation caused by ground contact.

B. Defective or damaged materials shall be replaced with new materials.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Extent of Work

1. Piping couplings, adapters, joints and accessories shall be provided in accordance with the requirements of the applicable Sections of Divisions 33 and 40 and as indicated.

2. The CONTRACTOR shall not be allowed to substitute any other type of coupling in lieu of the couplings as specified herein unless approved by the ENGINEER.

3. The CONTRACTOR shall assign the responsibility to the coupling manufacturer to review the piping connection to the equipment and submit any modifications to the ENGINEER for review.

B. Pressure Rating

1. Couplings, adapters and joints shall be designed for the pressure as defined in respective pipe sections, or as indicated on the Piping Schedule, whichever is greater.

C. Seals

1. Seal elastomer materials shall be selected to be compatible with the fluid service, pressure and temperature. They shall be composed of elastomeric-compound material that will not deteriorate from age under normal storage or use conditions.

2. Where couplings are used in water containing dissolved ozone residual or chloramines, seal material shall be Viton-A.

D. Coating

1. Couplings shall be lined and coated at the factory, unless otherwise indicated.

2. Coating shall be in accordance with the Section 09 96 00 - Protective Coating, unless otherwise indicated.

2.2 GROOVED TYPE COUPLINGS

A. General

1. Provide cast grooved type couplings where indicated, conforming to the requirements of AWWA C606 - Grooved and Shouldered Joints.

2. Grooved or banded piping shall conform to the coupling manufacturer's recommendations to suit the highest expected pressure.

   a. If grooved connections are used, the remaining thickness of pipe material after grooving shall be adequate to carry the load imparted to the joint. Joints for thin wall pipes shall be banded or welded with a collared end to fit coupling.

   b. Rolled pipe ends are not acceptable as a means of connection for metallic piping.

3. Equipment connections with mechanical-type couplings shall be provided with rigid grooved couplings or flexible type coupling with harness in sizes where rigid type couplings are not available, unless thrust restraint is provided by other means.

4. Couplings shall be electrically bonded.

5. For uniformity and compatibility of the piping components; grooving tools, grooved fittings, couplings, and valves shall be furnished by the same manufacturer as the coupling.

B. Grooved Type Couplings Manufacturer, or Equal

1. Grooved couplings for ductile iron piping shall be provided with flush seal gaskets.

   a. **Victaulic Company,** Style 31 (flexible or rigid)

   b. **Gustin-Bacon** (banded or grooved)

2. Grooved couplings for steel piping

   a. **Victaulic Company**, Style 177 / 77 / W77 (grooved, flexible, or rigid)

   b. **Victaulic Company**, Style 107H / 07 / W07 or HP-70 (grooved, rigid)

   c. **Gustin-Bacon** (banded or grooved)

3. Grooved couplings for stainless steel piping

   a. **Victaulic Company**, Style 489 (rigid)

   b. **Victaulic Company**, Style 77S (flexible)

   c. **Gustin-Bacon** (banded or grooved)

2.3 SLEEVE COUPLINGS

A. General

1. Provide sleeve couplings specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Sleeve couplings shall be in accordance with AWWA C219 - Standard for Bolted Sleeve-Type Couplings for Plain-End Pipe.

2. Couplings shall be constructed without pipe stop.

3. The middle ring shall be at least the same wall thickness as the pipe to which the coupling is connected and not less than 1/4-inch thick.

4. If the strength of the middle ring material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. For standard sleeve couplings, the coupling shall be either 5 or 7 inches long for pipe diameters up to and including 30-inch and 10 inches long for pipe diameters greater than 30-inch. For long sleeve couplings, the coupling shall be 16 inches long for all pipe diameters.

6. The followers shall be single-piece contoured mill sections welded and cold-expanded as required for the middle rings and of sufficient strength to accommodate the number of bolts necessary to obtain adequate gasket pressures without excessive rolling.

C. Insulating Sleeve Couplings

1. Where insulating couplings are required, both ends of the coupling shall be provided with a wedge-shaped gasket which assembles over a sleeve of an insulating compound material compatible with the fluid service in order to obtain insulation of coupling metal parts from the pipe.

D. Sleeve-Type Couplings Manufacturer, or Equal

1. **World Wide Metric, Inc.** (Dresser), Style 38

2. **Ford Meter Box Company, Inc.,** Style FC1 or FC3

3. **Smith-Blair, Inc.,** Style 411

2.4 FLANGED COUPLING ADAPTERS

A. Provide flanged coupling adapters specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Coupling bodies shall be fabricated from steel, ASTM A 512 - Cold-Drawn Butt-Weld Carbon Steel Mechanical Tubing or A 513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

2. Provide flanges in conformance with AWWA C207.

3. The body shall be at least the same wall thickness as the pipe to which the coupling is connected, but not less than 1/4 inch thick.

4. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. The follower flange shall be fabricated from steel, ASTM A 576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012.

C. Flanged Couplings Adapter Manufacturer, or Equal

1. **Smith-Blair**, Model 913

2. **Dresser**, Model 128-W

3. **JCM**, Model 303

2.5 DISMANTLING JOINTS

A. Provide dismantling joints products specifically designed suitable for the fluid service and pressure rating.

B. Construction

1. Coupling bodies shall be fabricated from steel, ASTM A 512 - Cold-Drawn Butt-Weld Carbon Steel Mechanical Tubing or A 513 - Electric-Resistance Welded Carbon and Alloy Steel Mechanical Tubing.

2. Provide flanges in conformance with AWWA C207.

3. The body shall be at least the same wall thickness as the pipe to which the coupling is connected, but not less than 1/4 inch thick.

4. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe.

5. The follower flange shall be fabricated from steel, ASTM A 576 - Steel Bars, Carbon, Hot Wrought, Special Quality or AISI C1012.

C. Dismantling Joints Manufacturer, or Equal

1. **Smith-Blair**, Model 975

2. **Dresser**, Model 131

3. **JCM**, Model 309

2.6 EXPANSION JOINTS

A. Piping subject to expansion and contraction shall be provided with sufficient means to compensate for such movement without exertion of undue forces to equipment or structures, accomplished with expansion loops, bellow-type expansion joints, or sliding-type expansion joints.

B. Expansion joints shall be provided with flanged ends and constructed of stainless steel, Monel, rubber, or other materials best suited for each individual service. Where expansion joints are used in water containing dissolved ozone residual or chloramines, provide Type 316 stainless steel expansion joints.

C. Where bellows-type expansion joints are mounted near the suction nozzle of the pump, a stainless steel internal liner shall be provided to minimize turbulence as the flow passes through the arches of the bellows.

2.7 TRANSITION COUPLINGS

A. Provide transition-coupling products specifically designed suitable for the fluid service and manufactured for the piping applications.

B. The transition couplings shall have function and design similar to the flexible couplings, joint and flanged coupling adapters for connecting piping having different outside diameters.

2.8 QUICK DISCONNECT COUPLINGS

A. Quick disconnect couplings shall be of the cam lock type (cam and groove type) consisting of a male adapter conforming to Specification MIL A-A-59326A. Male adapters shall be designed to receive a female coupler without requiring threading, bolting, or tools. Connections shall remain tight and leak proof up to full system pressures.

B. Each adapter shall be furnished with a dust cap complete with an 18-in long security chain of corrosion resistant material.

C. Unless otherwise indicated, the quick disconnect couplings shall be flanged connection to piping and materials shall be Type 316 stainless steel.

D. Quick connect couplings shall be as manufactured by LMC-Couplings; Dover Corporation; Ever-tite; or equal.

2.9 TAPPING SLEEVES

A. Provide tapping sleeve products specifically designed suitable for the fluid service and manufactured for the piping applications

B. Unless otherwise indicated, the tapping sleeves shall be of full circumference band with flanged outlet connection sized to ANSI class 150. Material of construction for the body and fastener shall be stainless steel.

C. Gasket material: Nitrile (Buna-N) or EPDM.

D. Tapping sleeves shall be as manufactured by Smith-Blair; Romac Industries; Dresser or equal.

2.10 MISCELLANOUS ADAPTERS

A. A special pipe adapter may be required to provide proper connection between different type of pipes and/or fittings. The adapter may be indicated on the Drawing with the pipe type or equipment. However, it is the CONTRACTOR'S responsibility to ensure proper connection between various type of pipes and pipe appurtenances. Provide adapters as required whether specifically indicated or not.

B. Provide piping adapter products specifically designed suitable for the fluid service and manufactured for the piping applications.

PART 3 -- EXECUTION

3.1 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

B. The CONTRACTOR shall have the coupling manufacturer's service representative verify the correct choice and application of couplings and gaskets, and the workmanship, to assure a correct installation.

C. The CONTRACTOR shall assign the responsibility to the couplings manufacturer to review the piping connection to the couplings and submit any modifications to the ENGINEER for review.

3.2 INSTALLATION

A. Where couplings are shown to connect piping to mechanical equipment such as pumps, the piping shall be aligned with the equipment point of connection and shall be perpendicular to the axis of the flange or fitting for which the piping is to be connected.

B. The couplings or the piping shall not impose excessive stress to the equipment connection to cause misalignment of the equipment.

C. Restrained Joints on couplings, adapters and joints

1. Couplings, adapters and joints on pressure lines shall be harnessed unless thrust restraint is provided by other means.

2. Harnesses shall be designed by the pipe manufacturer in accordance with AWWA Manual M11, or as indicated.

3. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed.

4. Where harness sets are installed near the suction and discharge of the pump, harness bolts shall have zero elongation in order to prevent misalignment of the pump imparted by the thrust within the piping system.

5. Other means of restraining the coupling such as set screws on piping will not be accepted.

END OF SECTION

SECTION 40 05 07 - PIPE SUPPORTS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide pipe supports, hangers, guides, and anchors, complete and in place, as indicated in accordance with the Contract Documents.

B. Where pipe support systems are not indicated on the Drawings, the CONTRACTOR shall design and provide the supports in accordance with this Section. The absence of pipe supports and details on the contract drawings does not relieve the Contractor of responsibility for sizing and providing the pipe supports.

C. The provisions of this Section shall apply to piping in Divisions 33 and 40.

D. 1. The CONTRACTOR shall provide supporting devices for supporting and restraining piping as indicated on the Drawings. Where pipe support devices and/or restraining details are not indicated on the Drawings, it is the CONTRACTOR'S responsibility to develop the details necessary to support and restraint the piping for a complete and functional pipe support system.

E. Seismic Forces

1. Pipe support details indicated in the Contract Drawings are sized for gravity loads only, and not designed to resist seismic forces.

2. The CONTRACTOR shall arrange for the services of a registered professional engineer licensed in the State of Oregon and experienced in pipe support design to design such pipe supports to resist seismic forces.

3. Piping support seismic shall be sized in accordance with Section 01 33 17 – Structural Design, Support and Anchorage.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Submit Shop Drawings which shall include the following information:

a. Drawings of pipe supports, hangers, anchors, and guides.

b. Pipe support schedule or layout indicating where the supports will be installed.

c. Calculations for special supports and anchors, stamped and signed by a registered professional engineer in the state where the project is located.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Code Compliance

1. Piping systems and pipe connections to equipment shall be properly anchored and supported in order to prevent undue deflection, vibration, and dislocation due to seismic events, line pressures, pipe weight, fluid weight, liquid movement, thermal changes, vibration, and probable forces applied during construction as well as stresses on piping, equipment, and structures.

2. Supports and parts thereof shall conform to the requirements of ASME B31.1 - Power Piping – Chapter II, Part 5 -Expansion, Flexibility, and Pipe Supporting Element and design the pipe supporting elements in accordance with the rules of MSS SP-58 -Pipe Hangers and Supports – Materials, Design and Manufacture, except as supplemented or modified in this Section.

3. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.

B. Structural Members

1. Wherever possible, pipes shall be supported from structural members.

2. Where it is necessary to frame structural members between existing members, such supplementary members shall be provided by the CONTRACTOR.

3. Supplementary members shall be in accordance with the requirements of the Building Code and the American Institute of Steel Construction, and shall be as acceptable to the ENGINEER.

C. Pipe Hangers

1. Pipe hangers shall be capable of supporting the pipe in operation, allowing free expansion and contraction of the piping and preventing excessive stress on equipment.

2. Hangers shall have a means of vertical adjustment after erection.

3. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe.

4. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves shall include hydraulic shock suppressors.

5. Hanger rods shall be subjected to vertical loading only.

D. Hangers Subject to Lateral or Axial Movement.

1. At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement.

2. Where lateral or axial pipe movement is greater than 1/2 inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold-to-hot position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the hot position.

E. Spring-Type Hangers

1. Spring-type pipe hangers shall be provided for piping subject to vibration or vertical expansion and contraction, such as engine exhausts and similar piping.

2. Spring-type hangers shall be sized per the manufacturer's printed recommendations and for the loading conditions encountered.

3. Variable spring supports shall be provided with means to limit misalignment, buckling, eccentric loading, or to prevent overstressing of the spring, and with means to indicate the compression of the spring.

4. Supports shall be capable of accommodating at least 4 times the maximum travel due to thermal expansion.

F. Riser Supports

1. Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.

G. Freestanding Piping

1. Freestanding pipe connections to equipment such as chemical feeders and pumps shall be firmly attached to support frames fabricated from angles, channels, or I-beams anchored to the structure.

2. Exterior, freestanding overhead piping shall be supported on fabricated pipe stands consisting of pipe columns anchored to concrete footings, or with horizontal, welded steel angles, and U-bolts or clamps securing the pipes.

H. Materials of Construction

1. Pipe support assemblies, including framing, hardware, and anchors, shall be of steel construction, galvanized after fabrication, unless otherwise indicated.

2. Submerged supports, as well as piping, conduits, and equipment in hydraulic structures located two feet above water level, shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel, unless otherwise indicated.

3. Piping in chemical and corrosive service areas shall be supported with support assemblies, including framing, hardware, and anchors constructed of Type 316 stainless steel or FRP, unless otherwise indicated.

4. Corrosive service areas are indicated in section 40 05 00 -1.2 Definitions - Corrosive Service.

I. Point Loads

1. Meters, valves, heavy equipment, and other point loads on PVC, or other plastic pipes, shall be supported on both sides, according to manufacturer's recommendations, in order to avoid undue pipe stresses and failures.

2. In order to avoid point loads, the supports on PVC, or other plastic piping shall be equipped with extra wide pipe saddles or galvanized steel shields for general service and Type 316 stainless steel shields for chemical or corrosive areas.

J. Concrete Anchors

1. Unless otherwise indicated, concrete anchors for pipe supports shall be according to the following table; consult the ENGINEER for any anchor applications not appearing on the table.

2. Anchor embedment shall be in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork.

Pipe Support Application	Type of Concrete Anchor
New Concrete	Use embedded concrete insert anchors on a grid pattern. Use **Grinnell (Anvil International), Tolco**, or equal.
Existing Concrete	Use non-shrink grouted anchors, expansion anchors, or epoxy anchors. Epoxy anchors are not permitted for vertical hanging applications or where sustained tension is exerted on the anchor. Exceptions: Expansion anchors and epoxy anchors are not permitted for pipe supports subject to vibrating loads. Epoxy anchors are not permitted where the concrete temperature is in excess of 100 degree F or higher than the limiting temperature recommended by the manufacturer.
Vibratory Loads and High-Temperature Conditions	Use non-shrink grouted anchors.

K. Noise Reduction

1. In order to reduce the transmission of noise in piping systems, copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar suitable material at each pipe support, bracket, clip, or hanger.

2.2 SUPPORT SPACING

A. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads.

B. Where pipe spacing are indicated on the Drawings and are referenced to a Standard Detail, that requirement shall take preference over the general requirements of this section.

C. Pipe support spacing shall not exceed the maximum indicated spans. Piping with grooved joint couplings, flexible joints, and bend fittings shall be balanced supported by a minimum of two pipe supports per pipe length, one at near each joint/fitting.

D. For temperatures other than ambient temperatures or those listed, and for other piping materials or wall thicknesses, the pipe support spacings shall be modified in accordance with the pipe manufacturer's recommendations.

E. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of loading effects.

F. Steel Pipe

1. Where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing below.

2. Support Spacing for standard wall or heavier welded steel, stainless steel or alloy steel pipe.

Nominal Pipe Diameter, Inches	Maximum Span, ft (Water Service)
1/2	6
3/4 and 1	8
1-1/4 to 2	10
3	12
4	14
6	16
8 and 10	18
12 and 14	20
16 and 18	22
20 and greater	24

G. Ductile Iron Pipe

1. Install supports for ductile iron pipe in accordance with the recommendations of the Ductile Iron Pipe Research Association (DIPRA) Design of Ductile Iron Pipe on Supports.

2. As a minimum, where support spacing is not indicated on the Drawings, the CONTRACTOR shall use the spacing indicated in the following schedule:

Nominal Pipe Diameter, inches	Support Configuration

All diameters	two supports per pipe length, with one of the two supports located at a joint

H. Schedule 80 PVC and CPVC Pipe

Nominal Pipe Size, inches	100 °F and below
1	5
1-1/2	5.5
2	6
3	7
4	7.5
6	9
8	9.5
10 and larger	10

I. Other Pipe Materials

1. Support spacing for pipe constructed of other materials shall be based on design temperature and in accordance with the pipe manufacturer's recommendations.

2.3 MANUFACTURED SUPPORTS

A. Stock Parts

1. Where not specifically indicated, designs that are generally accepted as exemplifying good engineering practice and using stock or production parts shall be utilized wherever possible.

2. Such parts shall be locally available, new, of best commercial quality, and designed and rated for the intended purpose.

B. Manufacturers, or Equal

1. **Basic PSA, Inc.**

2. **Bergen-Paterson Pipe Supports Group**

3. **Grinnell**

4. **Power Piping Company**

5. **TOLCO (Eaton B-Line)**

2.4 COATING

A. Unless otherwise indicated, fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products and shall receive protective coatings in accordance with the requirements of Section 099600 – Protective Coating.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. General

1. Pipe supports, hangers, brackets, anchors, guides, and inserts shall be installed in accordance with the manufacturer's printed instructions and per ANSI/MSS SP-58 Pipe Hangers and Supports- Materials, Design, Manufacture, Selection, Application and Installation.

2. Embedded concrete inserts for pipe hangers and supports shall be coordinated with the formwork.

B. Appearance

1. Pipe supports and hangers shall be positioned in order to produce an orderly, neat piping system.

2. Hanger rods shall be vertical, without offsets.

3. Hangers shall be adjusted to line up groups of pipes at the proper slope for drainage and venting, as close to ceilings or roofs as possible, and without interference with other WORK.

3.2 FIELD FABRICATION

A. Quality Control

1. Field fabricated pipe hangers and supports shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available.

2. Hangers and supports shall be neat in appearance without sharp corners, burrs, or edges.

END OF SECTION

SECTION 40 05 24 - STEEL PIPE

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide steel pipe and appurtenances, complete and in place, in accordance with the Contract Documents.

B. The requirements of Section 40 05 00 - Piping, General and 40 05 07 – Pipe Supports apply to the WORK of this Section.

PART 2 -- PRODUCTS

2.1 PIPE MATERIAL

A. Water, Air, Fuel Gas, Oil, Steam, and Waste Service: Unless otherwise indicated, galvanized and black steel pipe shall conform to ASTM A 53 Type E or S- Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless or ASTM A 106 - Seamless Carbon Steel Pipe for High Temperature Service, Grade B, and shall be Schedule 40 or 80, as indicated in the Piping Schedule. Steel pipe provided under this specification shall be cement mortar lined in accordance with AWWA C205 where used for pump discharge piping. Pipe shall be fusion bonded epoxy lined and coated where used for pump suction piping in accordance with Section 09 96 00.

2.2 PIPE JOINTS

A. Black steel pipe for general service shall have threaded ends with NPT threads, welded joints, or flanged joints. Threaded joints shall be made up with Teflon tape and welded joints may have butt-weld fittings, socket-weld fittings, or flanges. Where indicated, black steel pipe shall have grooved ends for shouldered couplings or plain ends for sleeve-type couplings.

B. Black steel pipe for chlorine or sulfur dioxide pressure service shall be socket-welded except where required to match mating fittings of vacuum regulator-check units, gas filters, valves, diaphragm units, gauges, and switches.

C. Galvanized steel pipe shall have threaded ends with NPT threads made up with Teflon tape. Where indicated, galvanized steel pipe shall have grooved ends for shouldered couplings or plain ends for sleeve-type couplings.

D. Where pressure conditions permit, black and galvanized steel pipe may have push-on joints for compression type fittings. For high pressure service these joints shall be harnessed.

2.3 FITTINGS

A. Common Use: The following fittings shall be provided for galvanized or black steel pipe, as indicated in the Piping Schedule:

1. Threaded malleable iron fittings conforming to ASME B 16.3 - Malleable-Iron Threaded Fittings, Classes 150 and 300.

2. Threaded cast iron fittings conforming to ASME B 16.4 - Cast Iron Threaded Fittings, Class 125 and 250.

3. Forged steel socket welded fittings conforming to ASME B 16.11 - Forged Fittings, Socket - Welding and Threaded.

4. Butt welding fittings conforming to ASME B 16.9 - Factory-Made Wrought Steel Butt Welding Fittings, Schedule 40 or 80, as indicated.

5. Threaded cast iron drainage fittings conforming to ASME 16.12 - Cast Iron Threaded Drainage Fittings.

6. Flanged steel fittings conforming to ASME B 16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy and Other Special Alloys.

7. Grooved ductile iron fittings with grooving dimensions conforming to AWWA C606 - Joints, Grooved and Shouldered Type.

8. Compression-type steel fittings with armored Buna S gaskets for plain end pipe.

PART 3 -- EXECUTION

3.1 GENERAL

A. Installation, inspection and field testing of the pipes shall in accordance with the requirements of Section 40 05 00 - Piping, General.

END OF SECTION

SECTION 40 91 00 - PROCESS INSTRUMENTATION AND CONTROL

PART 1 GENERAL

A. GENERAL

1. This project consists of replacing pump, motor and VFD for two influent pumps (Pumps #2 and #4) at the Kellogg Creek water reclamation facility in Milwaukie Oregon.

2. Specific instrumentation and control task included in this project are listed below:

   a. Integrate new VFD motor controls into the existing PLC (PLC1) in the influent pump station. The new VFD motor controls will utilize existing Input/Output (IO) points that were used for the old pump motor controls.

   b. Integrate MAS-801 pump protection system. This task is to be completed by the pump supplier.

3. Programming for Programmable Logic Controller (PLC) and Human Machine Interface (HMI) shall be by client or client designated system integrator.

4. Contractor shall provide wire terminations in control panel and on devices and support startup testing related to wiring and power.

B. The contractor/vendor shall provide local Process Control and Instrumentation System (PICS) for each subsystem or piece of equipment that is complete and operable in accordance with the Contract Documents.

C. The work is located at the Water Environment Services of Clackamas County, Oregon Kellogg Water Reclamation Facility. The Work is located at existing sites, which has wastewater treatment facilities in operation. The Contractor/Vendor shall coordinate its work to minimize disruption of existing facilities.

1.2 RESPONSIBILITIES

A. The contractor/vendor shall perform the following work:

1. Implementation of motor controls and VFD’s.

   a. Prepare submittals as called out in this and following sections in Division 40.

   b. Build and test control panels/systems.

   c. Prepare spare parts submittals.

   d. Oversee and certify installation, startup and commissioning of motor controls, VFD’s and MAS-801 pump protection system.

   e. Prepare owner’s O&M manual for motor controls, VFD’s and pump safety system.

f. Conduct training for new pump operation and troubleshooting.

B. Control and SCADA Programming:

1. The engineer or client representative will provide programming for PLC/HMI to integrate the new pumps into the existing SCADA and control system.

PART 2 PRODUCTS

2.1 THE REQUIREMENT

A. GENERAL

1. See the pump procurement specification section for motor control, VFD and pump safety system requirements.

PART 3 EXECUTION

3.1 THE REQUIREMENT

A. The pump supplier/vendor shall provide configuration and programming for VFD's and MAS 801 pump protection system.

3.2 RESPONSIBILITIES

A. SUBMITTALS:

1. See the pump procurement and electrical specifications for submittal requirements.

B. STARTUP TESTING/QUALITY ASSURANCE:

1. Power verification: verify proper supply power voltage is applied to the panel, device or instrument.

2. Field IO checkout: Verify instrument IO points are properly terminated at the device and control panel and the signals are functioning properly.

3. Instrument configuration: configure instruments to provide proper signals to the control system and local displays.

4. Verify proper operation of all instruments and sensors.

5. Verify proper operation of all motors and actuators.

6. Perform testing of MAS-801 pump protection system and provide Modbus TCP register to plant staff to be used for additional data monitoring of protection system via Ethernet Network.

C. GAURANTEE:

1. The vendor shall repair or replace any control system components that fail or are found defective during the original equipment manufacturer's warranty period.

D. PRODUCT HANDLING:

1. The contractor/vendor shall crate or package control equipment and instrumentation as needed to prevent damage during shipping to the work site. This includes protection from physical damage and moisture.

E. MANUFACTURER'S REPRESENTATIVE SERVICES:

1. The contractor shall employ the services of the manufacture to startup and commission vendor supplied standalone control systems at the plant site. The representative shall ensure proper operation of the equipment and control system in local mode prior to running the system in remote automatic mode.

END OF SECTION

SECTION 40 91 09 - PRESSURE DETECTION DEVICES

PART 1 GENERAL

1.1 THE REQUIREMENT

A. **General:** The contractor/vendor shall furnish and install all pressure detection devices, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 40 91 00 - Process Control and Instrumentation Systems apply to this Section.

1.2 CONTRACTOR SUBMITTALS

A. **General:** The Shop Drawings and Technical Manual, shall be submitted in conformance with Section 40 91 00 and Section 01 33 00 - Contractor Submittals.

B. **Detail:** Provide specific part numbers, selected options for each component or part so as to clearly indicate what item has been selected. Provide details for any selected accessories or additional item needed for each component. Clearly note any exceptions to the item specifications.

1.3 QUALITY ASSURANCE

A. **General:** The accuracy of each instrumentation system or loop shall include the following.

1. Verify proper power and signal wire terminations.
2. Ensure proper power voltage is applied to the device.
3. Check for correct output signal

1.4 MANUFACTURER'S REPRESENTATIVE SERVICES

A. **General:** None required for this section

1.5 PRODUCT HANDLING

A. **General:** Product shall be properly crated/protected to prevent damage and moisture intrusion during shipping and handling.

PART 2 PRODUCTS

2.1 GENERAL**:**

All devices specified herein shall conform to the requirements of the Contract Documents.

2.2 ELECTRONIC GAUGE PRESSURE TRANSMITTERS

A. Components: Electronic gauge transmitters shall consist of a capsule assembly, bottom works, vent plug, drain plug, cover flange, process connector and connection, amplifier unit, integral indicator, terminal box with cover, block and bleed valves, and conduit connections.

B. Operating Principles: Pressure applied to the unit shall be transmitted by a sealed fill fluid to both sides of a sensing diaphragm. The sensing diaphragm and the sensor body shall function as the moving and fixed electrodes, respectively, of a differential capacitor. As the applied pressure causes the diaphragm to move, the capacitance of the cell shall change

C. Performance Requirements: The amplifier unit shall convert the change in capacitance to a 4 to 20 mA DC signal, 2 wire type, with an allowable loop load of no less than 600 ohms. Static pressure rating shall be a minimum of 500 psig. The maximum over-range pressure limit shall be a minimum of 150 percent of the range. Span shall be adjustable over a minimum of 5:1 range. External adjustments shall include zero and span. Output signal damping shall be provided as an internal adjustment. Equipment shall be suitable for an ambient operating range of minus 40 degree F to plus 212 degrees F. The integral indicator shall be calibrated in process units. Power supply shall be 24 VDC. Accuracy, including linearity and repeatability, shall be a plus or minus 0.2 percent of span. Gauge pressure transmitters used for flow service shall include square root extraction to produce an output signal linearly proportional to flow. Wetted parts, including block and bleed valve parts, shall be constructed of 316 stainless steel. Pressure display shall have Nema 4x rated external buttons and 8-digit LCD display.

D. Diaphragm seals (with oil fill) shall be provided for all switches, except those mounted on air and potable waterlines

E. MANUFACTURER:

1. Rosemount 3051GP
2. OR Engineer approved equal

F. SCOPE OF SUPPLY:

1. None.

2.3 PRESSURE GAUGE

A. Pressure gauges shall be 4-1/2 inches in diameter, liquid-filled, bottom connected, with white laminated dials and black graduations. Windows shall be shatterproof glass. Gauges shall have a blowout disc and be encased in phenolic, steel or cast iron. Measuring element shall be a stainless steel bourdon tube with welded, stress-relieved joints. Socket shall have wrench

flats. Movement shall be rotary geared, all stainless steel material. All pressure gauges shall be provided with a pulsation snubber constructed of 316 stainless steel and a ball isolation valve. Accuracy shall be plus or minus 0.5 percent range to 150 percent of the working pressure or vacuum of the pipe or vessel to which they are connected.

B. Diaphragm seals (with oil fill) shall be provided for all gauges, except those mounted on air and potable waterlines.

C. MANUFACTURER:

1. Ashcroft 1279
2. OR engineer approved equal

D. SCOPE OF SUPPLY

1. Pump 2 discharge header pressure, 0-30 psi
2. Pump 4 discharge header pressure, 0-30 psi

PART 3 EXECUTION

3.1 GENERAL:

Installation and wiring shall be per manufacture’s requirements.

END OF SECTION

SECTION 40 92 00 - CONTROL PANELS AND COMPONENTS

PART 1 GENERAL

1.1 SUMMARY

A. This section includes requirements for:

1. Fabrication and assembly of all instrumentation enclosures, control panels and components provided under this contract, including but not limited to:

a. Custom built instrumentation and SCADA Control Panels, including, Remote Telemetry Units (RTU), Master Telemetry Units (MTU) and Local Control Panels (LCP).

b. Control components.

B. Related Sections:

1. The Contract Documents are a single integrated document, and as such all divisions and sections apply. It is the responsibility of the Contractor and its Subcontractors to review all sections to ensure a complete and coordinated project.

1.2 REFERENCES, SPECIFICATIONS AND CODES

A. Control panels shall comply with the requirements of NEC, NEMA and UL.

1.3 DEFINITIONS

A. Specific Definitions:

1. The term "panel" in this Section is interchangeable with the term "enclosure."

1.4 SYSTEM DESCRIPTION

A. Panel Dimensions:

1. Minimum dimensions are scalable from or as indicated on Drawings and are based upon manufacturer's noncertified information. It is the responsibility of the Contractor or manufacturer to design and size all panels:

a. Size panels to provide space for all equipment, wiring, terminations, and other items in the panel, including space for future build out.

b. Maximum Panel Depth:

1) 24 inches, unless otherwise indicated.

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00, Contractor Submittals.

B. Provide a control panel submittal, for each control panel and enclosure being provided on this project, including but not limited to:

1. Product Data:

a. Enclosure construction details and NEMA type.

b. Manufacturer's literature and specification data sheets for each type of equipment to be installed within or on the panel or enclosure clearly marked to show model and options for selected component.

2. Shop Drawings:

a. Scaled, detailed exterior panel (front and side views) and interior panel layout showing equipment arrangement and dimensional information.

b. Detailed control wiring schematics including control power distribution, IO wiring, networks etc.

c. Complete nameplate engraving schedule.

d. Structural details of fabricated panels.

3. Complete and Detailed Bills of Materials:

a. A bill of material list, including quantity, description, manufacturer, part number, serial number, vendor name and spare part list where required, shall be submitted for each of the PCIS system components. Bills of material shall include all items within an enclosure.

b. Provide the bill of material on CD-ROM in Microsoft Excel format.

4. Calculations:

a. For assembled enclosures, provide calculations for:

1) Expected temperature rise inside enclosure.
2) Expected duration of up time for back up power system (UPS or battery).
3) Approximate wire duct percent fill.

1.6 QUALITY ASSURANCE

A. Assemble panels, enclosures, and rack systems along with all internal and external devices, wiring, equipment, and materials in a facility that is recognized by Underwriters Laboratories to assemble and certify UL-labeled control panels:

1. Provide all components and equipment with UL 508 listing.

2. All control panels shall be labeled as follows, unless the equipment in the panel and the design in the Contract Documents cannot be reasonably modified to meet the requirements for the specified labeling:

   a. UL 508A for general control panels not in hazardous locations.

   b. UL 698 for control panels in hazardous locations.

   c. UL 698A for control panels not in hazardous locations but contain intrinsically safe barriers for devices located in hazardous locations.

B. Nonlisted, complex and unique equipment may be evaluated and approved by a third party testing agency, with prior approval by the Owner. Provide report documenting the testing standard, specification, method of testing and that the equipment and materials meet appropriate designated standards or have been tested and found suitable for use in a specified manner.

   1. Provide fuses for all equipment that is not UL listed.

1.7 DELIVERY, STORAGE AND HANDLING

A. Crate all panels for shipment using a heavy framework and skids:

   1. Provide wrapped waterproof flexible material for covering materials, where applicable, to protect against physical damage in transit.

   2. Provide suitable shipping stops and cushioning material for all instruments shipped with the panel to prevent damage due to mechanical shock during shipment.

   3. For large panels, provide removable lifting lugs to facilitate handling.

1.8 PROJECT SITE CONDITIONS

A. Provide enclosures suitable for the location and environmental conditions in which they are located, and in the NEMA types in accordance with project specifications and drawings.

1.9 WARRANTY

A. One Year Warranty from time of Delivery and Acceptance.

PART 2 PRODUCTS

2.1 GENERAL

A. The contractor/vendor shall provide the stations to satisfy the functional requirements in the relevant mechanical equipment and instrumentation and control specifications. Each station shall be fabricated with UL labeled components.

B. The controls shall be 120 V maximum. Where the electrical power supply is 240 V, single phase or 480 V, 3 phase, the system shall be provided with a fused control power transformer.

C. Each panel shall be provided with identified terminal strips for the connection of external conductors. The CONTRACTOR shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use.

D. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.

E. Enclosures:

1. Enclosures shall be NEMA 4X stainless steel for outdoor, corrosive or wet areas.

2. Enclosures, shall be NEMA 12 for dry indoor, non corrosive areas.

3. Outdoor mounted panels shall be provided with thermostatically controlled heaters.

4. Provide screened weep holes for draining condensation.

2.2 MANUFACTURERS

A. As listed below in the individual component paragraphs.

B. Provide instruments and other components performing similar functions of the same type, model, or class, and from one manufacturer.

2.3 MATERIALS

A. Construct and finish enclosures using materials capable of withstanding the mechanical, electrical, and thermal stresses, as well as the effects of humidity and corrosion that are likely to be encountered in normal service:

1. Enclosures shall be NEMA 250 type as indicated in Panel Drawings.

2. Enclosures shall have the following properties:

a. NEMA I:

1) Finished/Coated Steel.

b. NEMA 4:

1) Steel with gasketed door, rain tight.

c. NEMA 4X:

1) Stainless steel Type 316 (unless indicated Type 304 on Drawings).

d. NEMA 12:

1) Steel with gasketed door, dust-tight.

e. NEMA 7:

1) Cast aluminum.

B. Bolting Material:

1. Commercial quality 1/2-inch diameter, stainless steel hex-head grade five bolts, nuts and washers, with unified coarse (UNC) threads.

2. Carriage bolts for attaching end plates.

3. All other bolted joints shall have S.A.E. standard lock washers.

2.4 MANUFACTURED UNITS

A. Panels/Enclosures:

1. Manufacturers:

a. Hoffman Engineering or equal.

2. Panel Assembly:

a. General guidelines for panel fabrication include:

1) Continuous welds ground smooth.

2) Exposed surfaces free of burrs and sharp edges.

3) Base formed of heavy channel iron, either galvanized or powder coated, minimum 1/2-inch holes at 12-inch spacing to accommodate anchoring of freestanding enclosures to floor.

b. Construct enclosure and mounting panel using stretcher level sheet metal having minimum thickness not less than the following sizes (U.S. Standard Gauge):

1) Use heavier sheet metal to meet seismic requirements at the Project Site or when required due to equipment requirements.

Enclosure Height (inches)	Minimum Enclosure Steel Thickness	Minimum Back Mounting Panel Thickness
Up to 57	12	12
57-69	12	10
69-82	12 except 10 on back	10
82 or more	10	10

c. Construct supporting frame structure with angled, channeled, or folded rigid section of sheet metal, rigidly attached to and having essentially the same outer dimensions as the enclosure surface and having sufficient torsional rigidity to

resist the bending moments applied via the enclosure surface when it is deflected.

d. Provide stiffeners for back mounting panels in enclosures larger than 4 feet. In addition, secure the panels in place by collar studs welded to the enclosure.

e. Door Construction:

1) Turned-back edges suitably braced and supported to maintain alignment and rigidity without sagging.

a) Sufficient width to permit door opening without interference with rear projection of flush mounted instruments.

b) Heavy gauge piano type continuous stainless steel hinges.

c) For NEMA 12, 4 and 4X, provide oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.

d) Gasket installed to seal against roll lip on the enclosure opening.

2) Latches:

a) For panels each door provided with a three-point latching mechanism and locking handle with rollers on the ends of the latch rods. Latch rods connected to a common door handle, hold doors securely, forming a compressed seal between door and gasket, at the top, side, and bottom.

(1) Provide padlock for each enclosure with padlock provisions.

3) Include an oil-tight key-locking, three-point latching mechanism on each door:

a) Provide two keys per panel.
b) All locks keyed the same.

4) For large type NEMA 4 and NEMA 4X cabinets, not available with three-point latching hardware, provide multiple clips and padlock hasps.

5) Provide quick release latches for all NEMA 4 and 4X enclosures.

6) Panel Cut-Outs:

a) Cut, punch, or drill cutouts for instruments, devices, and windows. Smoothly finish with rounded edges.

b) Allow a minimum of 3-inch envelope around all displays, controllers, and monitors.

c) Reinforce around cut-outs with steel angles or flat bars for the following:

(1) Large panel cutouts; for example, openings for local operator interfaces.

(2) Pilot device groupings, where the removed metal exceeds 50 percent of the available metal.

B. Outdoor Panels: Supplementary requirements for panels located outdoors are as follows:

1. All enclosures located outdoors shall be explicitly designed and rated for outdoor service by the manufacturer.

2. Bases: Heavy channel, gasketed iron bases, flanges up, for anchoring to pad.

3. Provide exterior drip edge for top of door frame.

4. Provide thermostatically controlled heater.

C. Arrangement of Components:

1. Arrange panel internal components for external conduit and piping to enter into panel either from above or below.

2. Arrange panel instruments and control devices in a logical configuration associating pushbutton and selector switches with related readout devices.

3. Mount internal control components on an internal back-panel. Devices may be mounted on the side-panel only by special permission from the Engineer.

4. All control panel mounted operator interface devices shall be mounted between 4 feet and 6 feet above finished floor.

D. Disconnect Switches

1. See over current protection below.

E. Over Current Protection:

1. Main over current Device:

a. Where the electrical power supply voltage to the control panel is more than 120VAC, provide the panel with a flange mounted disconnect handle operating a molded case circuit breaker, and provide a control power transformer for 120VAC circuits:

1) Mechanically interlocked the disconnect switch with the control enclosure doors so that no door can be opened unless the power is disconnected, and the disconnect switch cannot be closed until all doors are closed.

2) Disconnect switch shall be lockable in the OFF position.

3) Provide means to defeat the interlock.

4) Disconnect switches shall be heavy duty, fusible, single throw. Fuses shall be provided.

b. Control Panels Supplied with 120VAC:

1) Provide an internal breaker with the line side terminals covered by a barrier.

2) Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring the source to be disconnected before opening the door to the enclosure.

2. Selection and Ratings of Protective Devices:

a. Interrupting Ratings: Not less than the system maximum available fault current at the point of application.

b. Voltage Rating: Not less than the voltage of the application.

c. Select current rating and trip characteristics to be suitable for:

1) Maximum normal operating current.

2) Inrush characteristics.

3) Coordination of the protective devices to each other and to the source breaker feeding the panel.

3. Provide a separate protective device for each powered electrical device:

a. An individual circuit breaker for each 120VAC instrument installed within its respective control panel and clearly identified for function.

b. An individual fuse for each PLC discrete output. Provide with individual fuse with blown fuse indication external of the I/O card:

1) Size external fuse to open before any I/O card mounted fuses.

2) An individual fuse for each discrete input loop.

3) An individual 1/2-amepre fuse for each 4 to 20 mA analog loop powered from the control panel.

4) Install protective devices on the back mounting panel and identify by a service nameplate in accordance with the wiring diagrams.

4. Control Circuit Breakers

a. DIN Rail Mounting on 35mm rail.

b. Manual OPEN-CLOSE toggle switch.

c. Rated 250 VAC.

d. Interrupting Rating:

1) 10kA or available fault current at the line terminal, whichever is higher.

e. Current ratings:

1) As required for the application.

5. Fuse Holders:

a. Fused Terminal Blocks.

b. DIN Rail mounting on 35mm rail.

c. Suitable for specified AWG wire.

d. Rated for 10 amperes at 600 volts.

e. Screw terminal type.

f. 8mm.

g. Finger safe protection for all terminals for conductors.

h. Terminals:

1) Plainly identified to correspond with markings on the diagrams. Permanent machine printed terminal identification.

i. Wire size 22-12 AWG.

j. Color:

1) Grey.

k. Indication:

1) 120VAC NEON.

l. Indication:

1) 24VDC LED.

F. Conductors and Cables:

1. Power and Control Wiring:

a. Materials:

1) Stranded, soft annealed copper.

b. Insulation:

1) 600-volt Type MTW.

c. Minimum Sizes:

1) Primary Power Distribution:

a) 12 AWG.

2) Secondary Power Distribution:

a) 14 AWG.

3) Control:

a) 16 AWG.

d. Color:

1) ac Power (Line and Load):

a) Black.

2) ac Power (Neutral):

a) White.

3) ac Control:

a) Red.

4) dc Power and Control:

a) Blue.

5) dc Power common white with blue stripe.

6) Ground:

a) Green.

G. Signal Cables:

1. Materials:

a. Stranded, soft annealed copper.

2. Insulation:

a. 600-volt, PVC outer jacket.

3. Minimum Size:

a. 18 AWG paired.

4. Overall aluminum shield (tape).

5. Copper drain wire.

6. Color:

    a. Two Conductors:

        1) Positive (+): White, red.
        2) Negative (-): Black.

    b. Three Conductors:

        1) Positive (+): White.
        2) Negative (-): Black.
        3) Signal: Red.

    c. Insulate the foil shielding and exposed drain wire for each signal cable with heat shrink tubing.

H. Conductor Identification:

1. Identify all conductors and cables with wire markers.
2. Readily identified without twisting the conductor.

I. General Wiring Requirements:

1. Wiring Methods:

    a. Wiring methods and materials for panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise specified.

2. Install all components in accordance with the manufacturer's instructions included in the listing and labeling.

3. Where the electrical power supply voltage to the control panel is more than 120VAC, provide the panel with a flange mounted disconnect and control power transformer. Mechanically interlocked the disconnect switch with the control enclosure doors so that no door can be opened unless the power is disconnected, and the disconnect cannot be closed until all doors are closed.

    a. Provide means to defeat this interlock.

4. Control panels supplied with 120VAC:

    a. Provide an internal breaker with the line side terminals covered by a barrier.

    b. Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring the source to be disconnected before opening the door to the enclosure.

5. Provide a nameplate on the cover of the control panel identifying all sources of power supply and foreign voltages within the control panel.

6. Provide transformers, protective devices, and power supplies required to convert the supply voltage to the needed utilization voltage.

7. Provide surge protection device on input supply power.

8. Provide nonmetallic ducts for routing and organization of conductors and cables:

    a. Size ducts for ultimate build-out of the panel, or for 25 percent spare, whichever is greater.

    b. Provide separate ducts for signal and low voltage wiring from power and 120VAC control wiring:

        1) 120VAC:

            a) Grey colored ducts.

        2) 24VDC:

            a) White colored ducts.

9. Cables shall be fastened with cable mounting clamps or with cable ties supported by any of the following methods:

    a. Screw-on cable tie mounts.
    b. Hammer-on cable tie mounting clips.
    c. Fingers of the nonmetallic duct.

10. The free ends of cable ties shall be cut flush after final adjustment and fastening.

11. Provide supports at the ends of cables to prevent mechanical stresses at the termination of conductors.

12. Support panel conductors where necessary to keep them in place.

13. Wiring to rear terminals on panel-mount instruments shall be run in nonmetallic duct secured to horizontal brackets run adjacent to the instruments.

14. Conductors and cables shall be run from terminal to terminal without splice or joints.

    a. Exceptions:

        1) Factory applied connectors molded onto cables shall be permitted. Such connectors shall not be considered as splices or joints.

15. The control panel shall be the source of power for all 120VAC devices interconnected with the control panel including, but not limited to:

    a. Instruments and both mounted in the control panel and remotely connected to the control panel.

    b. Solenoid Valves.

2.5 PANEL COMPONENTS

A. Pilot Devices:

1. General:

a. Provide operator pushbuttons, switches, and pilot lights, from a single manufacturer.

b. Size:

1) 30.5 mm.

c. Heavy duty oil tight.

d. Pushbuttons:

1) Contacts Rated: NEMA A600.

2) Furnish one spare normally open and normally closed contact with each switch, or more as shown in the Contract Drawings.

e. Selector Switches:

1) Contacts Rated:

a) NEMA A600.

2) Knob type.

3) Furnish one spare normally open contact and normally closed contact with each switch, or more as shown in the Contract Drawings.

4) Provisions for locking in the OFF position where lockout provisions are indicated.

f. E-Stop Pushbuttons:

1) Maintained position.
2) Mushroom head.
3) Red color.

g. Pilot Lights:

1) Type:

a) LED.

2) Push to Test.

3) Lamp Color:

a) On/Running/Start:

(1) Red.

b) On Forward:

(1) Red.

c) On Reverse:

(1) Red.

d) Off/Stop:

(1) Green.

e) Power:

(1) White.

f) Ready:

(1) White.

g) Alarm/Failure:

(1) Amber.

h) Opened:

(1) Red.

i) Closed:

(1) Green.

j) Auto:

(1) White.

k) Manual:

(1) Amber.

l) Local:

(1) White.

m) Remote:

(1) Amber.

2. Indoor and Outdoor Areas:

    a. NEMA Type 4/13.

    b. Manufacturers and Products: One of the following:

        1) Allen-Bradley; Type 800T or equal.

3. Corrosive Areas:

    a. NEMA 4X.

    b. Corrosion resistant.

    c. Exterior parts of high impact strength fiberglass reinforced polyester or multiple-layer epoxy coated zinc.

    d. Manufacturers and Products: One of the following:

        1) Allen-Bradley; Type 800T or equal.

4. Hazardous (Classified) Areas/Class 1 Division 2:

    a. NEMA 4X.

    b. Corrosion resistant.

    c. Exterior parts of high impact strength fiberglass reinforced polyester or multiple-layer epoxy coated zinc:

        1) All contacts contained within a hermetically sealed chamber:

            a) Pushbuttons.
            b) Selector switches.
            c) Push-to-test contacts on pilot lights.

        2) UL listed and labeled for Class I Division 2 areas.

            a) Manufacturers and Products: One of the following:

                (1) Allen-Bradley; Type 8001-1 or equal

B. Signal Isolators and Converters:

1. Furnish signal isolators that provide complete isolation of input, output, and power input:

    a. Minimum Isolation Level:

        1) 1.5 kV AC/50-Hz for at least 1 minute.

    b. Adjustable span and zero.

c. Accuracy:

1) Plus or minus 1 percent of span.

d. Ambient Temperature Range:

1) Minus 20 degrees C to plus 65 degrees C.

2. Manufacturers and Products:

a. One of the following:
b. Phoenix Contact; MCR Series or equal.

C. Relays:

1. General:

a. For all types of 120VAC relays, provide transient surge protection across the coil of each relay.

b. For all types of 24VDC relays, provide a free-wheeling diode across the coil of each relay.

2. General Purpose:

a. Magnetic control relays.

b. NEMA A300 Rated:

1) 300 volts.
2) 10 amps continuous.
3) 7,200 VA make.
4) 720 VA break.

c. Plug-in type.

d. LED indication for relay energized.

e. Coil Voltages:

1) As required for the application.

f. Minimum Poles:

1) 3PDT.

g. Touch Safe Design:

1) All connection terminals to be protected against accidental touch.

h. Enclose each relay in a clear plastic heat and shock-resistant dust cover.

i. Quantity and type of contact shall be as shown on Drawings or as needed for system compatibility.

j. Relays with screw-type socket terminals.

k. Provide additional (slave/interposing) relays when the following occurs:

1) The number or type of contacts shown exceeds the contact capacity of the specified relays.

2) Higher contact rating is required in order to interface with starter circuits or other equipment.

l. DIN rail mounting on 35-mm rail.

m. Ice cube type relays shall be provided with retainer clips to secure relay in socket.

n. Integrated label holder for device labeling.

o. Manufacturers and Products:

1) One of the following:

a) Phoenix Contact; PLC series.
b) Potter and Brumfield; Type KRP or KUP.
c) IDEC; R* Series (* = H, J, R, S, U).
d) Allen-Bradley; Type 700 H Series.
e) Square D; Type K.

3. Terminal Block Relays:

a. DIN Rail Mounting on 35mm rail.

b. Magnetic control relays.

c. NEMA Rated:

1) B300/R300.

d. Electromechanical relay interchangeable with solid state relays.

e. Plug-in type.

f. LED coil indication.

g. Coil voltages:

1) as required by application.

h. Screw type socket terminals.

i. Poles:

1) single pole, double throw.

j. Integrated label holder for device labeling.

k. Touch safe design. All connection terminals to be protected against accidental touch.

l. Quantity and type of contact shall be as shown on Drawings or as needed for system compatibility.

m. Manufacturers and Products:

1) Allen-Bradley 700 series or equal.

4. Time Delay:

a. Provide time delay relays to control contact transition time.

b. Contact Rating:

1) 240 volts.
2) 10 amps continuous.
3) 3,600 VA make.
4) 360 VA break.

c. Coil Voltage:

1) As required for the application.

d. Provide electronic type with on-delay, off-delay, and on/off delay:

1) For off delay use the power off time delay relays. Where the required timing range exceeds capability of the off delay relay use signal off delay where power loss will not cause undesirable operation or pneumatic time delay relays.

e. Minimum Poles:

1) 2PDT.

f. Units include adjustable dial with graduated scale covering the time range in each case.

g. Minimum Timing Range:

1) 0.1 second to 10 minutes, or as required for the application.

h. Manufacturers and Products:

1) One of the following:

a) IDEC; GT3 series.
b) Allen-Bradley; Type 700 HR Series.
c) Or equal.

D. Magnetic starters shall be:

1. NEMA, IEC or dual NEMA/IEC rated.

2. FVNR type unless indicated otherwise.

3. Combination starters with magnetic only instantaneous trip circuit breakers such as Eaton Electrical MCP, G.E. Mag-Break, or equal.

4. Minimum size: NEMA size 1.

E. Terminal Blocks:

1. Din rail mounting on 35-mm rail.

2. Suitable for specified AWG wire.

3. Rated for 30 amperes minimum at 600 volts.

4. Screw terminal type.

5. Provide mechanism to prevent wire connection from loosening in environments where vibration is present. This mechanism shall not cause permanent deformation to the metal body.

6. Finger safe protection for all terminals for conductors.

7. Construction:

a. Polyamide insulation material capable of withstanding temperature extremes from minus 40 degrees C to 105 degrees C.

8. Terminals:

a. Plainly identified to correspond with markings on the diagrams:

1) Permanent machine printed terminal identification.

2) Disconnect type field signal conductor terminals with socket/screw for testing.

3) Identify terminals suitable for use with more than one conductor.

4) Position:

a) So that the internal and external wiring does not cross. To provide unobstructed access to the terminals and their conductors.

5) Provide minimum 25 percent spare terminals.

6) Manufacturers:

a) Entrelec or equal.

9. Fuses (Holders) and Circuit Breakers:

a. Fuse Holders:

1) Modular Type:

a) DIN rail mounting on 35-mm rail.

b) Touch Safe Design:

(1) All connection terminals to be protected against accidental touch.

c) Incorporates blown fuse indicator.

2) Provide Nameplate Identifying each Fuse.

3) Manufacturers:

a) Entrelec or equal.

F. Power Supplies:

1. Design power supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the system operation.

2. Convert 120VAC to 24VDC or other dc voltages as required for the application.

3. Provide backup 24VDC power supply units to automatically supply the load upon failure of the primary supply.

4. Provide power supply arrangement that is configured with several modules to supply adequate power in the event of a single module failure:

5. Provide Automatic switchover upon module failure.

6. Alarm contacts monitored by the PLC.

7. Sized to provide 40 percent excess rated capacity.

8. UL 508C listed to allow full rated output without de-rating.

9. Provide fuse or short-circuit protection.

10. Provide a minimum of one set of dry contacts configured to change state on failure for monitoring and signaling purposes.

11. Output Regulation:

    a. Plus or minus 0.05 percent for a 10 percent line change or a 50 percent load change, with remote voltage sensing.

12. Operating Temperature Range:

    a. 0 to 50 degrees C.

13. DIN rail mounting on 35-mm rail.

14. Provide self-protecting power supplies with a means of limiting de current in case of short circuit.

15. Manufacturer:

    a. Sola or equal.

G. Industrial Ethernet Switches:

1. IP Ethernet switch.

2. Four 100/100BaseTX RJ-45 Ports or more as needed.

3. -40C to 70C Operating temperature range.

4. Auto sensing 10/100BaseTX.

5. DIN rail mountable enclosure.

6. 24VDC Input voltage.

7. Include minimum of one 1000BaseSX Multimode GB Fiber Optic Port (ST Connector) only as needed or required by project drawings.

8. Manufacturer N-Tron or equal.

H. Wire Duct:

1. Provide flame retardant plastic wiring duct, slotted with dust cover.

2. Type:

    a. Wide slot.
    b. Narrow slot.
    c. Round hole.

3. Manufacturer: Panduit or equal

2.6 ACCESSORIES

A. Provide panels with an inside protective pocket to hold the panel drawings. Ship panels with one copy of accepted Shop Drawings including, but not limited to, schematic diagram, connection diagram, and layout drawing of control wiring and components in a sealed plastic bag stored in the panel drawing pocket.

1. Provide 15-inch floor stands or legs where needed or as indicated in specifications.

2. Provide nameplate to each panel as indicated on Drawings.

B. Provide a nameplate with the following markings that is plainly visible after installation:

1. Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the panel can be identified.

2. Supply voltage, phase, frequency, and full-load current.

3. Short-circuit current rating of the panel based on one of the following:

a. Short-circuit current rating of a listed and labeled assembly.
b. Short-circuit current rating established utilizing an approved method.

C. Lighting:

1. Provide one luminaire for each section, on the interior of the panel, spaced evenly along the top-front of the enclosure door opening(s):

2. Covered or guarded.

3. Provide on-off door-activated switches where indicated on Drawings.

4. Provide 18-watt fluorescent lamp for indoor enclosures less than 30 inches wide.

5. Provide 40-watt fluorescent lamp for enclosures larger than 30 inches wide:

a. Provide additional fixtures for every 36 inches of width.

D. Receptacles:

1. Provide one duplex receptacle located every 4 feet of enclosure width, spaced evenly along the back mounting panels.

2. GFCI, 125-volt, single-phase, 15-ampere.

E. Grounding: Provide the following:

1. Grounding strap between enclosure doors and the enclosure.

2. Equipment grounding conductor terminals.

3. Provide equipment ground bus with lugs for connection of all equipment grounding wires.

4. Bond multi-section panels together with an equipment grounding conductor or an equivalent grounding bus.

5. Identify equipment grounding conductor terminals with the word "GROUND", the letters "GND" or the letter "G," or the color green.

6. Signal (24VDC) Grounding: Terminate each drain wire of a signal (shielded) cable to a unique grounding terminal block, or common ground bus at the end of the cable as shown on the loop drawings.

7. Ensure the continuity of the equipment grounding system by effective connections through conductors or structural members.

8. Design so that removing a device does not interrupt the continuity of the equipment grounding circuit.

9. Provide an equipment-grounding terminal for each incoming power circuit, near the phase conductor terminal.

10. Size ground wires in accordance with NEC and UL standards, unless noted otherwise.

11. Connect all exposed, noncurrent-carrying conductive parts, devices, and equipment to the equipment grounding circuit.

2.7 SPARE PARTS

A. Provide a minimum of 10 percent spare lamps (minimum 2) and one spare lens for each color pilot lamp in each panel.

PART 3 EXECUTION

3.1 CALIBRATION AND TESTING

A. GENERAL:

1. Calibration and testing shall be performed in accordance with Section 409100

2. TESTING:

a. Panel fabricator shall conduct the following test prior to panel shipment:

1) Check panel power distribution such that the indicated fuse or circuit breaker in fact provides power to devices indicated on wiring schematics.

2) Check for proper fuse and circuit breaker size.

3) Power up all devices in the control panel to check for proper operation.

4) Test for correct operation and indication of all selector switches, push buttons and indicator lights.

5) Verify proper operation of variable frequency drives as well as correct response to remote speed control signal and speed feedback signal.

6) Verify correct operation and settings of timing relays.

7) Test all PLC digital inputs for proper operation from the field IO terminal block all the way to the PLC.

8) Test all PLC analog inputs for proper operation from the field IO terminal block all the way to the PLC. Analog inputs shall be tested using a 4-20mA or 0-10VDC signal source to verify input signals at 25, 50, 75 and 100% of full scale.

9) Test all PLC digital outputs for proper operation from the PLC to the field terminals, including any interposing relays in the output circuit.

10) Test all PLC analog output for proper operation from the field IO terminal block all the way to the PLC. Analog outputs shall be verified using a multimeter at 25, 50, 75 and 100% of full scale.

11) Check Ethernet network connections and switch operation.

B. TEST REPORT:

1. The contractor/vendor shall provide a test report detailing the test procedure and results of the testing conducted according to section B above.

END OF SECTION

SECTION 43 20 00 - PUMPS, GENERAL

PART 1 -- GENERAL

1.1 THE SUMMARY

A. Provide pumps and pumping appurtenances, complete and operable, as indicated in accordance with the Contract Documents.

B. The provisions of this Section shall apply to pumps and pumping equipment throughout the Contract Documents, except where otherwise indicated.

C. The requirements of Section 46 01 00 – Equipment General Provisions, apply to this Section.

D. Unit Responsibility

1. The pump manufacturer shall be made responsible for furnishing the pumps, motors, and VFDs as one package and for the coordination of design, assembly, testing, and installation of the WORK of each specific pump Section.

2. The CONTRACTOR shall be responsible to the OWNER for compliance with the requirements of each specific pump Section.

1.2 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Submit pump name, identification number, and specification Section number.

2. Performance Information

a. Submit performance data curves showing head, capacity, horsepower demand, NPSHr3 required, and pump efficiency over the entire operating range of the pumps. Submit efficiency curves of motors and VFDs.

b. Require the equipment manufacturer to indicate the head, capacity, required horsepower, pump efficiency, and NPSHr corresponding to each flow condition indicated in the respective performance requirement paragraph of each individual pump specification section. Indicate on the pump curve the Allowable Operating Region (AOR), Preferred Operation Region (POR), and minimum submergence required at maximum flow for vertical and submersible pumps.

c. Submit performance curves at intervals no greater than 100 RPM from the specified minimum speed to maximum speed for each centrifugal pump equipped with a variable speed drive.

3. Operating Range

a. Require the manufacturer to indicate the limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration.

4. Submit assembly and installation drawings, including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

5. Submit data, in accordance with the requirements of Section 26 05 10 – Electric Motors, for the electric motor proposed for each pump.

6. Submit an elevation drawing of the proposed local control panel, showing panel-mounted devices, details of enclosure type, a single-line diagram of power distribution, current draw of the panel, and a list of terminals required to receive inputs or to transmit outputs from the local control panel.

7. Submit a wiring diagram of field connections, with identification of terminations between local control panels, junction terminal boxes, and equipment items.

8. Submit a complete electrical schematic diagram.

C. Rotodynamics and Structural Analyses

1. The CONTRACTOR shall perform and submit torsional, lateral, and structural analyses in reference to ANSI/HI 9.6.8 Guideline for Dynamics of Pumping Machinery. and as amended by these Specification for the following pumps:

a. Pumps with variable speed drives of 100 horsepower and greater.

2. Rotodynamics and Structural Analyses: A highly qualified third party engineer, such as Engineering Dynamics, Mechanical Solutions, or equal, approved in writing by the ENGINEER, shall perform a complete torsional, lateral and structural vibration analysis for each distinct motor, driven equipment, and variable frequency drive system:

a. These analyses shall demonstrate that in no case shall the maximum stress on any component exceeds the endurance limits of the motor-flywheel-coupling-driven equipment train materials of construction. Calculation of shaft deflection in the vicinity of the seal journal shall be submitted.

b. Submit calculations of torsional and lateral rotodynamics analysis for the VFD, motor with flywheel, couplings, drive shaft and pump as complete assembled system. The analysis report shall include the specific items as follows:

1) Critical Speed Analyses. The undamped torsional natural frequencies of the complete drive train shall be at least 25 percent above or 25 percent below any possible steady state excitation frequency within the specified operating range from minimum to maximum continuous speed. If torsional frequencies fall within the margin specified, the pump manufacturer shall provide remedial measures to correct the deficiency to meet the requirement. If the margin cannot be avoided by any possible remedial measures, a finite element analysis of the rotating assembly shall be prepared to determine the endurance stress factor of safety of the shaft material.

2) Endurance Fatigue Stress Factor of Safety. Shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications. In the event that the critical vibration frequency falls within the operating range of the equipment and the frequencies cannot be absolutely avoided by any means or methods, submit a stress analysis. Where shafts are subjected to fatigue stresses, such as frequent start and stop cycles, the mean stress shall be determined by using the modified Goodman Diagram. The maximum torsional stress shall not exceed the endurance stress limit of the shaft material with a minimum factor of safety of 2. If a keyway is cut into the shaft, the endurance limit of the shaft material shall be reduced by using the appropriate stress concentration factor for fillets cut into the shaft, shoulder, and/or the key seat.

3) The CONTRACTOR shall submit a detailed report of the analysis:

4) A description of the method used to calculate the natural frequencies.

a) A diagram of the mass elastic system.

b) A table of the mass moment and torsional stiffness of each element of the mass elastic system.

c) Campbell Diagram.

d) A mode shape diagram with peak stresses shown for each resonant frequency.

e) This analysis shall identify the dry and wet lateral critical(s), plus the torsional critical(s) speeds.

c. Structural analysis of shaft, baseplate, bearing support frame, natural frequency analysis of pump structure, motor and supporting structure shall be prepared. Certifications shall be submitted to the effect that the equipment and equipment supports including anchor bolts comply with seismic and wind design criteria in Section 01 33 17 – Structural Design, Support and Anchorage.

3. This WORK shall be performed prior to fabrication of the machinery, and it is subject to review by the ENGINEER. No fabrication shall be started until the ENGINEER has approved the analyses.

D. Technical Manual

1. Submit a Technical Manual containing the required information indicated in Section 01 33 00 – Contractor Submittals and each specific pump Section.

E. Spare Parts List

1. Submit a spare parts list containing the required information indicated in Section 01 33 00 – Contractor Submittals and each specific pump Section. Provide list for each pump or equipment item in Technical Manual.

F. Factory Test Data

1. For pumps that shall be factory witness tested, submit factory test plan showing piping diameter sizes and lengths, locations of valves and instruments that will be used during testing as part of shop drawing submittal.

2. For pumps that shall be factory witness tested, submit current calibration certificates of test instruments prior to testing.

3. Submit signed, dated, and certified factory test data for each pump system which requires factory testing.

4. Submit these data before shipment of equipment.

G. Certifications

1. Submit the manufacturer's certification of proper installation.

2. Submit the CONTRACTOR's certification of satisfactory field testing.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Compliance with the requirements of the specific pump Sections may necessitate modifications to the manufacturer's standard equipment.

B. Performance Curves

1. Provide centrifugal pumps with a continuously rising pump curve, or with a pump curve that does not cross the system curve within the pump curve’s “dip region.”

2. Unless otherwise indicated, the required shaft horsepower for the entire pump assembly at any point on the performance curve shall not exceed the rated horsepower of the motor or engine or encroach on the service factor.

3. For VFD driven pumps, the rated horsepower of the selected motor shall be 110 percent of the maximum brake horsepower required by the pump.

C. Compatibility

1. Provide entirely compatible components of each pump system provided under the specific pump Sections.

2. In each unit of pumping equipment, incorporate basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.

D. Balancing

1. Unless otherwise specified the rotating assembly shall be dynamically balanced to ISO 1940 G6.3.

2.2 MATERIALS

A. Provide materials suitable for the intended application.

B. For materials not indicated, provide high-grade, standard commercial quality, free from defects and imperfections that might affect the serviceability of the product for the purpose for which it is intended, and conforming to the following requirements:

1. Bowls and Casings

a. Provide cast iron pump casings constructed of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Castings, Class 30, or equal. Unless otherwise indicated on the specific pump sections, cast iron-fitted pumps shall be epoxy lined and coated for better efficiency.

2. Impellers

a. Impellers shall be Hard Iron, ASTM A352 Alloy IIIA, statically and dynamically balanced as specified in Section 43 25 06 for Dry Pit Submersible Solids Handling Pumps.

b. Where individual pump sections indicate stainless steel impellers or suppliers propose stainless steel impellers, such impellers shall be constructed of Type 316 stainless steel.

c. Where individual pump sections indicate bronze impellers, where suppliers proposes bronze impellers, or where the impeller material is not otherwise specified, such impellers shall be constructed of zero-lead aluminum bronze conforming to ASTM B 148 – Standard Specification for Aluminum-Bronze Sand Castings, or zero-lead, zincless nickel aluminum bronze ASTM –B 148-C95800.

3. Provide pump shafts constructed of Type 416 or 316 stainless steel.

4. Provide anti-friction bearings or zero-lead bronze bearings. Bronze bearings shall be Bismuth Tin Bronze ASTM B 584 C89835, or equal.

5. All elastomeric materials such as gaskets, seals, O-rings in contact with water with chloramine and ozone shall be Teflon, Viton-A or other materials compatible with the fluid service. Test certificate from a material testing laboratory to provide proof of test shall be made available to the ENGINEER if requested.

6. Miscellaneous stainless steel parts shall be of Type 316.

7. Provide anchor bolts, washers, and nuts in standard service (non-corrosive application) of galvanized steel in accordance with the requirements of Section 05 50 00 – Miscellaneous Metalwork.

8. Provide anchor bolts, washers, and nuts in corrosive service of stainless steel in accordance with Section 05 50 00 – Miscellaneous Metalwork.

2.3 PUMP COMPONENTS - GENERAL

A. Flanges and Bolts

1. Provide suction and discharge flanges conforming to ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, or ASME B16.5 - Pipe Flanges and Flanged Fittings dimensions. Pressure class shall be suitable for the application or as otherwise recommended by the pump manufacturer.

2. Provide flange bolts in accordance with the requirements of Section 40 05 00 – Piping, General.

3. Flange gaskets shall be in accordance with Section 40 05 00 - Piping, General

B. Lubrication

1. Pumps for sewage, sludge, and other process fluids shall be grease lubricated or as indicated.

C. Hand holes

1. Provide hand holes on pump casings shaped to follow the contours of the casing in order to avoid any obstructions in the water passage.

D. Drains

1. Provide and connect pipe gland seals, air valves, and cooling water drains to the nearest floor sink or drain, using galvanized steel pipe or copper tube that is properly supported with brackets.

E. Stuffing Boxes

1. Where stuffing boxes are indicated for the pump seal, provide stuffing boxes of the best quality, using the manufacturer's suggested materials best suited for the specific application.

2. For sewage, sludge, drainage, and liquids containing sediments, provide fresh-water-flushed seals, using lantern rings.

3. For submersible sewage pumps, packing gland type seal or mechanical seals per pump manufacturer standard.

4. If fresh water is not available, the seal shall be flushed with product water cleaned by a solids separator as manufactured by **John Crane Co., Lakos (Claude Laval Corp.),** or equal.

5. Conventional Packing Gland Type Seal

a. Unless otherwise indicated, provide packing material of Teflon braiding, containing 50 percent ultrafine graphite impregnation in order to satisfy the requirements listed in the table below.

b. Acceptable ring materials are asbestos-free die-molded packing rings of braided graphite material free of PTFE, **Chesterton 1400R** or equal, for non-potable water service, and braided PTFE material, **Chesterton 1725** or equal, that is listed under NSF Standard 61 for potable water service.

6. Mechanical Seals

a. Provide mechanical seals of the fresh water-flushed-type, unless otherwise indicated in which case use product water cleaned by a solids separator as indicated above. Seal materials in contact with water with chloramine and ozone shall be Teflon or Viton-A or equivalent material compatible with fluid service.

b. Provide conventional, non-split-type mechanical seals as manufactured by the following, or equal:

Sewage, Sludge, or Wastewater Pumps	Double seals	**John Crane Type 5620P, Flowserve Type ISCPP, Chesterton Type GDS** or **255**

c. Where indicated, circulate a buffer fluid at a minimum 20 psi above discharge pressure, or as required by the manufacturer, in order to maintain reliable seal performance.

d. Equip mechanical seals with non-clogging, flexible–mounted seats with elastomer secondary seals.

e. Provide wetted metal parts constructed of Type 316 stainless steel, Alloy 20, or Hastelloy B or C, whichever has the best corrosion resistance to the pumped fluid.

f. Where double seals are specified, provide double-balanced dual cartridge seals in order to allow for seal integrity in case of flush water pressure reversal.

g. Provide springs in single and double seals, in the non-wetted end of the seal.

h. Deliver fresh water to the seals through appropriate size piping with plug valves, strainers, pressure regulators, electrically operated solenoid valves, and rotameters.

2.4 PUMP APPURTENANCES

A. Nameplates

1. Equip each pump with a stainless steel nameplate indicating serial number(s), rated head and flow, impeller size, pump speed, and manufacturer's name and model number.

2.5 FACTORY TESTING

A. Conduct the following tests on each indicated pump system:

1. Motors

a. Test electric motors in accordance with the requirements of Section 26 05 10 – Electric Motors.

b. Furnish test results to the pump manufacturer prior to the pump test.

2. Variable Frequency Drives

a. Test variable frequency drives in accordance with the requirements of Division 26 – Variable Speed Drives section.

b. Furnish test results to the pump manufacturer prior to the pump test.

3. Certified Factory Non-Witnessed Test

a. Perform factory non-witnessed tests on all centrifugal pumps with drives up to and including 125 hp in accordance with the ANSI/HI 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Test and ANSI/HI 11.6, Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests

b. For pumps with drives from 15 horsepower and higher shall meet hydraulic acceptance criteria Grade "1U" at guaranteed design point unless otherwise indicated in the specific pump specifications. Such tests shall, at a minimum, consist of the following:

1) Hydrostatic test;

2) Performance Test:

a) Conduct performance testing at maximum speed, obtain a minimum of 5 hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, and record on data sheets as defined by the Hydraulic Institute Standards. One point shall be the flow rate at the design head;

b) For variable speed driven pumps, test each pump between maximum and minimum speed at intervals no greater than 100 RPM; During the test for each speed setting, obtain 5 hydraulic test readings in the same manner as described in Paragraph a.

c) Submit pump curves showing head, flow, bhp, NPSHr and efficiency results. The manufacturer’s certification shall be visible on each submitted curve;

3) Mechanical testing shall be limited to observation during the hydraulic performance test for any abnormal bearing temperature and pump vibration. Any deficiencies shall be corrected by the manufacturer.

4) NPSHr3

a) Perform a net positive suction head required test (NPSHr3) using one pump unit only. Pumps shall be NPSHr3 tested at maximum speed by taking five readings along the pump performance curve. Two of those points shall be NPSHr3 at maximum design point and at maximum operating point as described in the specified performance requirements in Section 43 25 06. .

b) Acceptance criteria shall be in accordance with ANSI/HI 14.6 or ANSI/HI 11.6.

c) If not required by the specific pump Section, submit the published manufacturer-calculated NPSHr3 curve.

5) Additional tests as indicated in the specific pump specification sections.

c. Perform tests using the completely assembled project pump, motor, and VFD system (if equipped with variable speed drive). Calibrated factory motor and VFD may be used in lieu of project motor and VFD.

d. Testing of prototype models will not be accepted.

e. Submit certification signed by a senior official of the pump manufacturer that the required pump shaft horsepower did not exceed the rated motor horsepower of 1.0 service rating at any point on the curve.

f. No equipment shall be shipped until the test data have been approved by the ENGINEER.

4. Certified Factory Witnessed Tests – Virtual

a. The CONTRACTOR shall coordinate a virtual (internet based) factory witnessed test with Flygt. Attendees will include the OWNER and ENGINEER.

b. Perform factory witnessed tests on all centrifugal pumps with drives 150 hp and larger in accordance with the certified factory non-witnessed test procedure indicated above for 15 hp to 125 hp pumps with the exception that the tests shall be witnessed by the OWNER and ENGINEER.

c. Vibration test shall be conducted simulating site conditions by mounting the pump assembly on supports of the same dimensions as the concrete pier and baseplates for the installed pump and motor assembly.

d. Mechanical tests shall be conducted in accordance with ANSI/HI 14.6 or ANSI/HI 11.6, Appendix E, Mechanical Test. Such tests shall, at a minimum, consist of the following:

1) Measure and record overall motor winding temperature

2) Measure and record motor and pump bearing temperatures.

3) Measure and record motor and pump vibration.

4) Acceptance criteria and mechanical test records shall be in accordance with ANSI/HI 14.6 or ANSI/HI 11.6, Appendix E, Mechanical Test.

5) Vibration Criteria shall be in accordance with Hydraulic Institute Standard 9.6.4 “American National Standard for Rotodynamic Pumps for Vibration Measurements and Allowable Values”.

e. The CONTRACTOR shall provide the OWNER and ENGINEER a minimum of 2 weeks notification prior to the test.

f. Excluding salaries, costs for the attendances of one representative for the OWNER and one representative for the ENGINEER shall be borne by the CONTRACTOR and shall be included in the Contract Price, including travel and subsistence costs. The cost shall include repetitive visits, if required. If additional witnessed testing is required due to failure of the pumps to meet specified conditions, expenses of the ENGINEER and OWNER shall be covered by the CONTRACTOR.

g. No equipment shall be shipped until the test data have been approved by the ENGINEER.

5. Acceptance

a. In the event of failure of any pump to meet any of the requirements, make necessary modifications, repairs, or replacements in order to conform to the requirements of the Contract Documents, and re-test the pump until found satisfactory.

PART 3 -- EXECUTION

3.1 MANUFACTURER'S SERVICES

A. Inspection, Startup, and Field Adjustment

1. Furnish an authorized service representative of the manufacturer at the Site continuously to supervise the following items and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:

a. installation of the equipment;

b. inspection, checking, and adjusting the equipment;

c. startup and field testing for proper operation; and

d. Performance of field adjustments to ensure that the equipment installation and operation comply with the indicated requirements.

B. Instruction of OWNER's Personnel

1. Furnish an authorized training representative of the manufacturer at the Site for the number of Days indicated in the specific pump Section, to instruct the OWNER's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment.

2. Furnish instruction specific to the model of equipment provided.

3. Qualifications

a. Furnish a representative with at least 2 years' experience in training.

b. Submit a resume for the representative, to be include in the training submittal.

4. Schedule the training a minimum of 3 weeks in advance of the first session.

5. Lesson Plan Review

a. Submit the proposed training material and a detailed outline of each lesson for review in advance of training session for OWNER's approval.

b. Incorporate review comments into the material.

6. The trainees will keep the training materials.

7. The OWNER may videotape the training for later use with the OWNER's personnel.

3.2 INSTALLATION

A. General

1. Install pumping equipment in accordance with the manufacturer's written recommendations.

B. Alignment

1. Field-test the equipment in order to verify proper alignment and freedom from binding, scraping, shaft run out, or other defects.

2. Measure the pump drive shafts just prior to assembly in order to ensure correct alignment without forcing.

3. Ensure that the equipment is secure in position and neat in appearance.

C. Lubricants

1. Provide the necessary oil and grease for initial operation.

3.3 PROTECTIVE COATING

A. Coat materials and equipment in accordance with the requirements of Section 09 96 00 – Protective Coating.

3.4 FIELD TESTS

A. Contractor shall provide a professional vibration analysis specialist (VAI) to perform on-site vibration testing. The work shall be directed by a registered professional mechanical engineer who has been providing vibration monitoring services for no less than 10 years. Submit VAI’s qualification for review 6 weeks prior to testing. An alternate analyst shall be provided if the proposed VAI’s qualifications are inadequate. The independent tasting laboratory’s team, including the vibration analysis specialist and any technicians required to complete the testing, shall provide continuous pressure, velocity and displacement values for pumps.

B. Field-test each pump system after installation simulating all of the operational scenarios as specified in order to demonstrate:

1. satisfactory operation without excessive noise and vibration. Testing shall include a comparison of measure installed flow and head including shutoff head, with the manufacturer’s curve data. Any discrepancy shall be resolved prior to acceptance by the OWNER;

2. Pumps shall be tested to confirm its ability to pump the fluid described in the detailed specification and to operate without clogging or fouling caused by material in the pump fluid at any operating condition within the range of service specified. Pump shall be accepted if it is demonstrated to be free of clogging or fouling conditions, of

any cause, as demonstrated by a 5 percent or greater capacity drift within 2 hours of sustained operation.

3. no material loss caused by cavitation;

4. no overheating of bearings; and,

5. Meet indicated head, flow, and efficiency at the design point.

C. Conduct the following field testing:

1. Provide a “bump test” when pump installation is complete to check system set up and operation prior to formal pump performance testing.

2. Startup, check, and operate the pump system over its entire speed range.

3. The suction and discharge knife gates are existing. Their seat conditions are not known and therefore, may not be able to withstand repeated throttling during the test. In order to minimize damage to the seats, minimize the number of field tests to check operation of the new pump prior to acceptance. Test each pump as follows:

   a. With all valves in wide open position, operate each pump at maximum speed and take reading of flow rate, suction and discharge pressure, motor and pump bearing housing vibration, motor and pump bearing housing temperatures.

   b. Adjust speed at 100 rpm increments from maximum speed to minimum speed. At each speed, take readings in the same manner as step a.

4. Unless otherwise indicated, vibration shall be within the amplitude limits recommended by the Hydraulic Institute standards at a minimum of 4 pumping conditions defined by the ENGINEER. One test point shall be the flow rate at the design head. Amplitude of vibration at the POR shall not exceed 0.34 in/s peak to peak in accordance with Hydraulic Institute Standard 9.6.4 (refer to Figure 9.6.4.2.5.1c).

5. Obtain concurrent readings of motor voltage, amperage, pump suction head, and pump discharge head for at least one pumping condition at each pump rotational speed, at 100-RPM increments when equipped with a variable speed drive.

6. Check each power lead to the motor for proper current balance.

7. Bearing Temperatures

   a. Determine bearing temperatures by a contact-type thermometer.

   b. Precede this test with a run time sufficient to stabilize bearing temperatures, unless an insufficient liquid volume is available to furnish such a run time.

8. Ensure that electrical and instrumentation tests conform to the requirements of the Section under which that equipment is specified.

D. Witnessing

1. Field testing will be witnessed by the ENGINEER.

2. Furnish 3 Days advance notice of field testing.

E. If the pumping system fails to meet the indicated requirements, modify or replace the pump and re-test as indicated above until it satisfies the indicated requirements.

F. Certification

1. After each pumping system has satisfied the requirements, certify in writing that it has been satisfactorily tested and that final adjustments have been performed.

2. Certification shall include the date of the field tests, a listing of persons present during the tests, and the test data.

G. The CONTRACTOR shall be responsible for costs of field tests, including related services of the manufacturer's representative, except for power and water, which the OWNER will bear.

H. If available, the OWNER'S operating personnel will provide assistance in field testing.

END OF SECTION

SECTION 43 25 06 – DRY-PIT SUBMERSIBLE SOLIDS-HANDLING PUMPS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide dry-pit submersible solids-handling pumps and appurtenant WORK, complete and operable, in accordance with the Contract Documents.

B. The requirements of Section 43 20 00 - Pumps, General apply to this Section.

C. The Supplier shall examine the Site conditions, intended application, and operation of the pump system and recommend the pump that will best satisfy the indicated requirements.

1.2 PERFORMANCE GUARANTEE AND EXTENDED PERIOD FOR CORRECTION OF DEFECTS

A. The Pump Supplier shall issue a Performance Guarantee for the pumps supplied to ensure that they meet the performance requirements listed in paragraph 2.2.C of this section and in related sections of these contract documents. Vibration amplitude acceptance criteria shall be in accordance with ANSI/HI 9.6.4.2.5.1C for Solids Handling Pumps with the exception that the vibration amplitude shall be no more than 0.34 in/sec as agreed by Owner and Manufacturer during design. A list of installations where this pump has been used for wastewater flows of similar flow rate shall be provided. As part of this performance guarantee, an extended period for correction of defects shall apply to the pumping equipment.

B. The CONTRACTOR shall correct defects in the pumping system upon notification from the OWNER within 6 years from the date of Substantial Completion. One year of this correction period is the standard correction period for construction work plus and additional 5 years for the pumping system warranty/performance guarantee. The repair shall include all costs for repair, parts, labor, and travel and living expenses. Extended period warranty certification letter shall be submitted. Corrections shall be completed within 5 Days after notification.

1.3 REFERENCES

A. American Society for Testing and Material (ASTM) International

1. A48: Standard Specification for Gray Iron Castings.

2. A352: Steel Castings, Ferritic and Martensitic, for Pressure Containing Parts, Suitable for Low-Temperature Service

B. American National Standards Institute (ANSI):

1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

C. Hydraulic Institute: Current Standards.

1. ANSI/HI 14.6: Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

2. ANSI/HI 11.6: Rotodynamic Submersible Pumps for Hydraulic Performance, Hydraulic Pressure, Mechanical and Electrical Acceptance Tests.

1.4 SUBMITTALS

A. Refer to Section 43 20 00 Pumps, General.

B. Complete information on the MAS 801 protection system, including all components and cables to make a complete operating system. Each pump MAS 811 Base Unit shall be provided to the VFD manufacturer for mounting in the VFD.

C. Complete information on the “Flygt MAS 801 Central Unit and HMI Panel” enclosure to be provided by the pump supplier. This enclosure shall accept a 120VAC 60HZ feeder and shall include all components internal as required.

D. Confirmation that integration and setup of the MAS 801 system will be performed by the pump supplier.

E. CONTRACTOR shall provide confirmation that pump cable overall length matches the conditions required for running from the pump up to and terminating in the VFD. Power and controls cables complete with termination kits that have sufficient length to span from the motor to the VFD.

F. Confirmation that the power and control cables required per pump are quantity of two (2), 1.54” outside diameter each, part # 941996 (S3x50 shielded power+3x25/3 ground+ S(4x0.5) control). Provide catalog information on pump cables.

G. Information related to CT’s. CT’s shall be provided to the VFD manufacturer for mounting in the VFD.

PART 2 -- PRODUCT

2.1 GENERAL DESCRIPTION

A. Identification: Pumps No. 2 and 4.

B. Operating Conditions: The WORK of this Section shall be suitable for long term operation under the conditions as indicated in this Specification.

Duty	Continuous
Drive	Variable speed
Ambient environment	Indoors
Ambient temperature, degrees F	35 to 115
Ambient relative humidity, percent	50 to 100
Fluid service	Raw sewage [see Note 1]
Fluid temperature, degrees F	40 to 80
Fluid pH range	6 to 8
Fluid specific gravity	1.0

Fluid viscosity, absolute centipoises at 60 degrees F	1.05
Project site elevation, ft msl	5 feet
Minimum available NPSH, ft absolute	32 ft
Maximum size of spheres to pass, in. dia	4

Note 1. Raw Sewage may contain small rocks, grit, organics, wood, floatables, and rag materials etc. up to 4 inches in size within wastewater.

C. Performance Requirements:

Maximum shutoff head, ft	100
Design flow pump head, TDH ft	46
Design flow capacity at maximum speed, mgd	14
Design flow minimum pump hydraulic efficiency, percent	77
Design flow NPSH required, ft absolute	24
Minimum flow capacity at minimum speed, mgd	5
Minimum flow pump head TDH, ft, plus or minus 3-ft	35
Minimum flow minimum pump hydraulic efficiency, percent	55
Maximum flow [16 mgd] NPSH required, ft absolute	36
Maximum pump speed, rpm	880
Minimum pump speed, rpm	575
Maximum motor speed, rpm (see note)	880
Minimum motor size, hp	170
Power Supply	460V, 3-Phase, 60 Hz
Motor Full Load current, amps	210

Note: VFD acceleration/deceleration ramping shall be adjustable from 0 to 60 seconds to bring pump from 0 to 100% speed. A ramp time of 15 to 30 seconds (or

faster ramping speed if required by the pump manufacturer to build up torque) is estimated to be the optimum to be adjusted during installation and startup. There are no known frequency jump points that must be avoided for this installation.

D. Pump Dimensions: Pump dimensions shall be in accordance with the requirements as indicated:

Min impeller diameter, in	505 mm
Min pump shaft dia, in	Per manufacturer recommendations
Min suction flange size, in	20
Min discharge flange size, in	16
Suction flange rating, ANSI, psi	125
Discharge flange rating, ANSI, psi	125

2.2 PUMP REQUIREMENTS

A. General: Components shall be designed to safely withstand forces resulting from flow reversals up to 125 percent of maximum speed within the pump during shutdown caused by power failure.

1. Each pump shall be capable of continuous operation at design flow (14 mgd) with a minimum wet well water level of 4.65 feet without cavitation or overheating of the motor. NPSH test shall verify that pump is not cavitating at the wet well level of 4.65 feet.

2. Each pump, with its cable and appurtenances, shall be able to withstand continuous submergence to a minimum depth of 65-feet, whether running or off, without leakage.

3. Each pump shall be able to operate for short periods up to 5 minutes at zero static suction head without causing any damage to any part of the unit.

4. Pumps shall be specifically designed to pump the fluid described in the detailed specification and contract documents and to operate without clogging or fouling caused by material in the pump fluid at any operating condition within the range of service specified. Clogging or fouling conditions may be of any cause, demonstrated by a 5 percent or greater capacity drift within 2 hours of sustained operation.

B. Construction: Construction of dry pit submersible solids-handling pumps shall conform to the following requirements:

Connections	Suction short radius cast iron, ductile iron or rolled steel flanged elbow and flanged discharge. Provide 6-inch handhole with bolted flange cover and stainless steel liner to match interior curvature of elbow.

Pump Design	Single stage, centrifugal type, close-coupled to sealed or submersible electric motor, for operation in dry or wet pit, without external cooling.
Impeller	Semi-open, multi-vane impeller designed to transport unscreened municipal type raw sewage, solids with fibrous materials. Impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the insert ring to keep impeller blades clear of debris.
Bearings	Permanently lubricated, heavy-duty axial and radial ball or roller bearings top and bottom, with a minimum L-10 life of 100,000 hours, at continuous, maximum load and speed, supported by detailed calculations, to be submitted with the Shop Drawings. Lower bearing housing shall include an independent thermal sensor to monitor bearing temperatures, activate alarm and shut down the pump. Upper bearing shall be insulated for VFD operation.
Seals	Dual mechanical tandem, one stationary and one revolving shaft seals with individual springs, tungsten carbide or silicon carbide ring, each not requiring any maintenance, and capable of withstanding 1.5 times pump shutoff head. The seals shall be oil lubricated, with moisture detector probes, alarm, and test circuits.
Oil Chamber	Provide oil chamber with sufficient volume to supply oil for lubrication and cooling of the shaft seals.
Support	Pump and motor assembly base plate bolted to reinforced concrete pedestal.
Cables	Cable connection box shall be submersible NEMA 6P (IP 68) to ensure that no water can enter the motor via the cables even when station is flooded. Include necessary cables for power connection, moisture detection, and overload protection, sheathed, coded, and suitable for submersible pumps, and of sufficient length for direct connection to the terminal boxes indicated. Power and control cables of sufficient length to span from electric motor to VFD shall be provided. Cables shall be connected to the pumps and tested at the factory.
Lifting Devices	Provide lifting lugs all rated at least 4 times the weight of the pump and motor.

C. Materials

Pump, volute, oil casing, sliding bracket, motor frame	cast iron, ASTM A48-No. 35B.

Impeller	Hard Iron, ASTM A352 Alloy IIIA, statically balanced.
Pump shaft	Martensitic stainless steel ASTM/AISI 431 with stainless steel sleeve.
Exposed bolts, nuts, washers	Type 316 stainless steel.
Mechanical seals	Independently operating tandem tungsten-carbide or silicon carbide and carbon rings with stainless steel springs suitable for raw sewage per pump manufacturer recommendation.
Insert rings	Hard Iron, ASTM A352 Alloy IIIA , with Brinell hardness for impeller and case per pump manufacturer recommendations.

D. MOTOR: Motor shall be induction type with squirrel cage rotor, shell design, housed in an air filled and water-tight chamber. Motor shall be inverter duty. It shall be submersible in accordance with IEC 60034 Standard and protection class IP 68. It shall be capable of operating continuously even when the pump station is flooded up to 65 feet. Motor stator winding shall be insulated with moisture resistant Class H insulation rated for 356 F. The junction chamber containing terminal board shall be hermetically sealed from the motor by an elastomeric compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. Motor shall be close coupled to the pump, variable speed driven, vertical, heavy-duty, premium efficiency, with closed loop cooling jacket, submersible electric motor mounted in dry pit, suitable for 480 volt, 3 phase, 60 Hz power supply capable of accepting the total, unbalanced thrust load imposed by the pump. All motor bearings shall be insulated to prevent premature damage due to current incursion from VFD or as recommended by pump manufacturer.

E. Approval: The pumping system, including the motor and wiring, shall be approved by a nationally approved testing agency for explosion-proof service. The system shall be rated Class I, Division 1, Group C and D service as determined by the National Electric Code and approved by a nationally recognized testing agency (UL or FM) at the time of opening Bids. The CONTRACTOR shall include in the Bid a copy of the certificate of approval.

F. Insulation: The pump motors shall be designed for continuous duty in hazardous locations. The stator and stator leads shall be deep moisture-resistant, triple varnished and insulated according to Class H, capable of withstanding a temperature rise of up to 356 degrees F (180 degrees C). The allowable temperature rise of the motor at full load condition shall not exceed 80 degrees C.

G. Stator: The motor stator shall be mounted in an air-filled, watertight casing and shall not be fixed in place by externally mounted screws which may cause leakage in the motor.

H. Motor Rating: Motors shall have service factors of 1.10 or greater. For motors driven by variable frequency drives, motor horsepower shall be the greater of:

1. Non-overloading conditions throughout the pump curve.

2. 1.15 times the horsepower required by the pump at maximum indicated flow.

I. Junction Box: The motor shall have a junction box capable of being sealed completely from the stator casing to prevent leakage through the junction box into the stator housing should a motor cable be damaged or have some other means to prevent leakage into the junction box under any condition.

J. Cable Entry: The cable entry water seal design shall be such that it precludes specific torque requirements to ensure a watertight and submersible seal. It shall permit no entry of water into any high voltage area even if the cable is severed below the water level.

K. Cooling System: Each motor shall be designed and rated to operate at maximum ambient air temperature of 104 degrees F and provided with an adequately designed close loop glycol solution cooling jacket that encircles the stator housing. A coolant circulating pump is attached to the pump shaft to circulate coolant through closed loop cooling jacket.

L. Motor Protection: Manufacturers' standard motor protection shall be provided as part of MAS 801 pump protection system including but not limited to a 3-axis vibration sensor that reads data in three directions x,y, z ; integral thermal sensors in the motors, one for each phase; bearing temperature sensors; float switches for leakage protection in junction box and stator housing; and water in oil detection shall be provided. These sensors shall be used in conjunction with and supplemented by external motor over-current protection located at the motor starter.

1. The pump protection MAS 811 Base Unit shall be installed in the VFD under Section 26 29 23 – Variable Frequency Drive Units.

2. The MAS 801 pump protection Central Unit and HMI shall be provided in an indoor NEMA 12 rated local control panel with a hinged door. This panel shall be no greater than 12" wide. The pump protection display (HMI) module shall be dead-front panel mounted. The pump supplier shall provide this panel pre-wired, complete and operable with the only field connections required by the CONTRACTOR for 120V power, Cat-6 Ethernet to the PLC, and Devicenet to the MAS 811 Base Units. Devicenet cable shall be provided by the pump supplier. Devicenet integration and set-up shall be provided by the pump supplier.

M. Flygt current transducer (CT) model 7RL, part # 14-404132 (typical of 3) shall be provided for installation into the VFD under Section 26 29 23 – Variable Frequency Drive Units. The CT's may be connected to the Flygt MAS-801 Power Analyzer (PAN 312) option unit under future Contract.

2.3 PUMP CONTROLS

A. Pumps shall be controlled as indicated in Instrumentation and Electrical Drawings and Specifications.

2.4 SPARE PARTS

A. List of recommended spare parts shall be provided in Technical Manual. No spare parts are required to be provided at time of pump installation.

2.5 FACTORY TESTING AND SHIPMENT

A. In addition to the factory tests in Section 43 20 00, the following procedures shall be included with the factory test prior to shipment:

B. Verification of the pump characteristic curves by testing at 1/4, 1/2, 3/4, and full flow and recording the measured head and motor current for each flow.

C. Verification of cavitation-free service and absence of motor overheating during conditions simulating the actual operating conditions after installation, whether submerged, semi-submerged, or dry.

D. Pump seals shall be designed for complete water tightness at 65-feet submergence for 30 minutes and data on factory testing and quality control shall be submitted with the Shop Drawings.

E. NPSHr3 (net positive suction head required test shall be performed on each pump. Acceptance criteria shall be in accordance with ANSI/HI 14.6.

F. Parts shall be properly lubricated and protected so that no damage or deterioration will occur even during a prolonged delay from the time of shipment until installation is completed and the pumps are ready for operation.

G. Finished ferrous surfaces not painted shall be properly protected to prevent rust and corrosion.

H. The finished surfaces of exposed flanges shall be protected by strong wooden blind flanges.

I. Each pump shall be properly crated to protect against damage during shipment.

2.6 MANUFACTURER – NO EQUAL

A. N-Series Impeller Pump as manufactured by Flygt Corporation

PART 3 -- EXECUTION

3.1 INSTALLATION

A. In addition to the requirements of Section 43 20 00, the CONTRACTOR shall ensure that anchor bolts are set only after the discharge piping has been properly installed, to ensure exact fit with embedded piping components.

3.2 SERVICES OF MANUFACTURER

A. Inspection, Startup, and Field Adjustment: The service representative of the manufacturer shall be present continuously at the Site to furnish the services required by Section 43 20 00 – Pumps, General.

B. Instruction of OWNER'S Personnel: The training representative of the manufacturer shall be present at the Site 2 days minimum to furnish the services required by Section 43 20 00 – Pumps, General.

C. For the purposes of this paragraph, a Day is defined as an 8-hour period at the Site, excluding travel time.

D. The ENGINEER may require that the inspection, startup, and field adjustment services above be furnished in 3 separate trips.

END OF SECTION

SECTION 46 01 00 - EQUIPMENT GENERAL PROVISIONS

PART 1 -- GENERAL

1.1 THE SUMMARY

A. The CONTRACTOR shall provide equipment and appurtenant WORK, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section shall apply to equipment throughout the Contract except where otherwise indicated.

C. All component and support systems of the equipment shall be designed and manufactured to withstand all forces such as internal or external, static, wind, dynamic and seismic loads (wind and seismic in accordance with Section 01 33 17 – Structural Design, Support and Anchorage) in order for the equipment to last throughout its expected life without premature failure. The project is located in a seismically active zone as specified in Section 01 33 17 – Structural Design, Support and Anchorage. Therefore, the manufacturer shall submit a certification signed and stamped by a registered engineer stating that the equipment was designed and manufactured to withstand all the loads specified in this paragraph. Submit a copy of that analysis for review by the ENGINEER.

D. Equipment Arrangement: Unless specifically indicated otherwise, the arrangement of equipment indicated is based upon information available from manufacturers at the time of design and is not intended to show exact dimensions particular to a specific manufacturer. Some aspects of the Drawings are diagrammatic and some features of the illustrated equipment arrangement may require revision by the CONTRACTOR to meet the actual equipment requirements proposed by the CONTRACTOR. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered by the CONTRACTOR to accommodate the equipment provided. No additional payment will be made to the CONTRACTOR for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the fabrication of equipment.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Equipment shall be in accordance with the following standards, as applicable and as indicated in each equipment specification:

1. American Society for Testing and Materials (ASTM).

2. American National Standards Institute (ANSI).

3. American Society of Mechanical Engineers (ASME).

4. American Water Works Association (AWWA).

5. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE).

6. American Welding Society (AWS).

7. National Fire Protection Association (NFPA).

8. Federal Specifications (FS).

9. National Electrical Manufacturers Association (NEMA).

10. Manufacturer's published recommendations and specifications.

11. Occupational Safety and Health Administration (OSHA).

12. Hydraulic Institute (HI)

B. The following standards are referenced in this Section:

ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800
ASME B16.5	Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy and other Special Alloys
ASME B46.1	Surface Texture
ANSI S12.6	Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors
ASME B1.20.1	General Purpose Pipe Threads (Inch)
ASME B31.1	Power Piping
ASME B31.3	Process Piping
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In. (100 mm through 3,600 mm)
AWWA D100	Welded Steel Tanks for Water Storage
ASTM A 48	Gray Iron Castings
ASTM A 108	Steel Bars, Carbon, Cold-Finished, Standard Quality

1.3 CONTRACTOR SUBMITTALS

A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Shop Drawings: Furnish complete drawings and technical information for equipment, piping, valves, and controls. Where indicated or required by the ENGINEER, Shop Drawings shall include clear, concise calculations showing equipment anchorage forces and the capacities of the anchorage elements proposed by the CONTRACTOR.

C. Spare Parts List: The CONTRACTOR shall obtain from the manufacturer and submit as part of Shop Drawings a list of suggested spare parts for each piece of equipment. CONTRACTOR shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.

1.4 QUALITY ASSURANCE

A. Costs: Responsibility shall be the CONTRACTOR'S for performing and paying the costs of inspection, startup, testing, adjustment, and instruction services performed by factory representatives. The OWNER will pay for costs of power and water. If available, the OWNER'S operating personnel will provide assistance in the field testing.

B. Inspection: The CONTRACTOR shall inform the local authorities, such as building and plumbing inspectors, fire marshal, OSHA inspectors, and others, to witness required tests for piping, plumbing, fire protection systems, pressure vessels, safety systems, cranes, and related items to obtain required permits and certificates, and shall pay inspection fees.

C. Quality and Tolerances: Tolerances and clearances shall be as shown on the Shop Drawings and shall be closely adhered to.

1. Machine WORK shall be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts. Members without machined or milled ends and which are to be framed to other steel parts of the structure may have a variation in the detailed length of not greater than 1/16-inch for members 30-feet or less in length, and not greater than 1/8-inch for members over 30-feet in length.

2. Castings shall be homogeneous and free from non-metallic inclusions and defects. Surfaces of castings which are not machined shall be cleaned to remove foundry irregularities. Casting defects not exceeding 12.5 percent of the total thickness and where defects will not affect the strength and serviceability of the casting may be repaired by approved welding procedures. The ENGINEER shall be notified of larger defects. No repair welding of such defects shall be carried out without the ENGINEER'S written approval. If the removal of metal for repair reduces the stress resisting cross-section of the casting by more than 25 percent or to such an extent that the computed stress in the remaining metal exceeds the allowable stress by more than 25 percent, then the casting may be rejected. Costs of casting new material shall be the CONTRACTOR'S responsibility as part of the WORK.

3. Materials shall meet the physical and mechanical properties in accordance with the reference standards.

D. Machine Finish: The type of finish shall be the most suitable for the application as recommended by the equipment manufacturer in micro-inches in accordance with ANSI B46.1. In the absence of manufacturer's recommendations, the following surface finishes shall be used:

1. Surface roughness not greater than 63 micro-inches shall be required for surfaces in sliding contact.

2. Surface roughness not greater than 250 micro-inches shall be required for surfaces in contact where a tight joint is not required.

3. Rough finish not greater than 500 micro-inches shall be required for other machined surfaces.

4. Contact surfaces of shafts and stems which pass through stuffing boxes and contact surfaces of bearings shall be finished to not greater than 32 micro-inches.

E. Manufacturer's Experience: Equipment manufacturer shall have a record of proven experience of at least 5 years of successful, troublefree operation in similar applications and size equal or larger than the equipment in this Contract. Where indicated in each individual equipment specifications, the CONTRACTOR shall submit this experience record to the ENGINEER for approval.

PART 2 -- PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Noise Level: When the equipment is in operation, no single piece of equipment shall exceed the OSHA noise level requirement of 105 dBA for one hour exposure per day.

B. High Noise Level Location: The CONTRACTOR shall provide one personal hearing protection station at each location defined as follows:

1. Outdoor Location: Any single equipment item or any group of equipment items that produce noise exceeding OSHA noise level requirements for a 2 hour exposure. Where such equipment is separated by a distance of more than 20-feet, measured between edges of footings, the area for each group of equipment shall be provided with a separate hearing protection station.

2. Indoor Location

a. Any single equipment item or any group of equipment items located within a single room not normally occupied, that produces noise exceeding OSHA noise level requirements for a 2 hour exposure.

b. Any single equipment item or any group of equipment items located within a single room normally occupied by workers that produces noise exceeding OSHA noise level requirements for an 8 hour exposure.

C. Personal Hearing Protection: The CONTRACTOR shall furnish 3 pairs of high attenuation hearing protectors in the original unopened packaging. The ear protectors shall be capable of meeting the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz. The hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband. The protectors shall be stored in a weatherproof, labeled, steel cabinet, provided at an approved location near the noise producing equipment.

D. Drive Trains and Service Factors: Service factors shall be applied in the selection or design of mechanical power transmission components. Components of drive train assemblies between the prime mover and the driven equipment shall be designed and rated to deliver the maximum peak or starting torque (whichever is the greatest), speed, and horsepower. Applicable service factors shall be considered, such as mechanical (type of prime mover), load class, start frequency, ventilation, ambient temperature, and fan factors. Drive train components include couplings, shafts, gears and gear drives, drive chains, sprockets, and V-belt drives. Unless otherwise indicated, the following load classifications shall apply in determining service factors:

Type of Equipment	Service Factor	Load Classification

Pumps		
centrifugal or rotary	1.0	Uniform
reciprocating	1.8	Moderate Shock
progressing cavity	1.0	Uniform
Cranes or Hoists	1.25	Moderate Shock

E. Mechanical Service Factors –

	Mechanical Service Factors	
	Electric Motor	**Internal Combustion Engine**
Uniform	1.25	1.50
Moderate Shock	1.50	1.75
Heavy Shock	2.00	2.25

F. For thermal rating adjustments such as start frequency, ambient temperature, and hourly duty cycle factor, ventilation factor, and fan factor, refer to gear manufacturer sizing information.

G. For service factors of electric motors, see Section 26 05 10 - Electric Motors.

H. Where load classifications are not indicated, the equipment manufacturer's recommendations for service factors shall be utilized.

I. Welding: Unless otherwise indicated, welding shall conform to the following:

1. Latest revision of AWWA D100.

2. Latest revision of AWWA C206.

3. Composite fabricated steel assemblies that are to be erected or installed inside a hydraulic structure, including any fixed or movable structural components of mechanical equipment, shall have continuous seal welds to prevent corrosion of hard-to-coat metallic surfaces.

4. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.

5. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material that are to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

J. Protective Coating: Equipment shall be painted or coated in accordance with Section 09 96 00 - Protective Coating, unless otherwise indicated. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil. Coated surfaces

shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.

K. Potable Water Contact: Materials immersed in or exposed to potable water shall be made of materials or coated compliant with NSF Standard 61. Bronze alloy materials in contact with potable water shall be constructed of zero-lead materials or materials whose lead content do not exceed the weighted average criteria as required by the Lead Reduction Act. Equipment manufacturer shall submit to the ENGINEER a certification of compliance with the requirement of NSF Standard 61 and the Lead Reduction Act.

L. Protection of Equipment: Machined and coated surfaces shall be protected by rust inhibitor material prior to shipment. Equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage. Equipment shall be protected from exposure to corrosive fumes and shall be kept thoroughly dry. Equipment with anti-friction bearings or sleeve bearings shall be protected from being damaged due to jarring motion during shipment. Pumps, motors, drives, electrical equipment, and other equipment having anti-friction or sleeve bearings shall be stored in weathertight storage facilities prior to installation. For extended storage periods, plastic equipment wrappers should be avoided to prevent accumulation of condensate in gears and bearings. In addition, motor space heaters shall be energized and shafts shall be rotated per manufacturer’s recommendation. Equipment delivered to the Site with rust or corroded parts shall be rejected. If equipment develops defects during storage, it shall be disassembled, cleaned, recoated, or otherwise corrected to restore it to original condition.

M. Identification of Equipment Items

1. At the time of shipping, each item of equipment shall have a legible identifying mark corresponding to the equipment number in the Contract Documents for the particular item.

2. After installation, each item of equipment shall be given permanent identification.

a. Pumps, compressors, and blowers of 150 horsepower or less shall receive acrylic plastic nametags.

b. Pumps, compressors, and blowers larger than 150 horsepower shall receive stainless steel plate nametags.

N. Vibration Isolators: Air compressors, blowers, engines, inline fans shall be provided with restrained spring-type vibration isolators or pads per manufacturer's written recommendations. Vibration isolations shall be provided with seismic restraint.

O. Equipment Maximum Allowable Vibration Level: Unless otherwise indicated, maximum allowable vibration level shall be in accordance with the acceptance criteria recommended by the reference Standard for that particular type of equipment

P. Shop Fabrication: Shop fabrication shall be performed in accordance with the Contract Documents and the Shop Drawings.

Q. Controls: Equipment and system controls shall be in accordance with Division 40 - Instrumentation.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Equipment Supports: Equipment components and supports, anchors, and seismic restrainers shall be adequately designed for static, dynamic, wind, and seismic loads. The design horizontal seismic force shall be the greatest of the following design criteria:

1. Design Criteria noted in Section 01 33 17 – Structural Design, Support and Anchorage.

B. Submit design calculations for equipment supports, anchors, and seismic restrainers signed and sealed by an engineer registered in the State wherein the project is to be built. Calculations shall account for forces and distribution of forces on supporting structures resulting from normal operation, normal operation plus seismic loadings, and normal operation plus wind loadings in accordance with Section 01 33 17 – Structural Design, Support and Anchorage.

1. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches above the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.

2. Seismic requirements: Freestanding and wall-hung equipment shall be anchored in place by methods that satisfy Section 01 33 17 – Structural Design, Support and Anchorage. Calculations shall be performed and signed and stamped for equipment weighing more that 400 pounds. Calculations shall analyze lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.

3. Wind requirements: Exterior freestanding equipment shall be anchored in place by methods that satisfy Section 01 33 17 – Structural Design, Support and Anchorage. Calculations shall be performed and signed and stamped, analyzing lateral and overturning forces and shall include a factor of safety against overturning equal to 1.5. Calculations shall include the distribution of forces imposed on the supporting structure and anchors, verifying that each anchor can develop the required resistance forces.

4. Anchors: Anchor bolts shall be in accordance with Section 05 50 00 - Miscellaneous Metalwork. CONTRACTOR shall determine the size, type, capacity, location, and other placement requirements of anchorage elements. Anchoring methods and leveling criteria in the manufacturer's literature shall be followed. Submit methods and criteria with the Shop Drawings.

5. Equipment Foundations: Unless otherwise indicated, mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 3.5-inch high concrete bases. Unless otherwise indicated on the Drawings, pumps, blowers, compressors and engine driven equipment shall be provided with a concrete foundation with a total weight equal to at least five times the weight of the equipment. Concrete foundations shall be isolated from the building floor in order to prevent transfer of vibration from the equipment to the building structure. The CONTRACTOR through the equipment manufacturer shall verify the size and weight of equipment foundation to insure compatibility with equipment.

6. Equipment Grout: Mechanical equipment installed on top of concrete foundations or bases shall be provided with non-shrink concrete or epoxy grout as indicated and as specified in Section 03 31 50 – Cast in Place Concrete**.** Grout shall be applied between the base plate and the concrete foundation or base in accordance with the grout manufacturer's recommendation. Grout shall be free of void space.

2.3 COUPLINGS

A. Mechanical couplings shall be provided between the driver and the driven equipment. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Unless otherwise indicated or recommended by the equipment manufacturer, coupling type shall be furnished with the respective equipment as follows:

Equipment Type	Coupling Type
Horizontal and end suction pumps	Gear or flexible spring
Vertical turbine pumps	3 piece spacer for solid shaft or double nut for hollow shaft
Vertical nonclog pumps, close coupled	Flexible disc pack
Screw pumps	Flexible spring, gear coupling, fluid coupling
Vertical nonclog pumps with extended shaft	Flexible disc pack or Universal joint with carbon fiber composite shaft and steady bearing support(s)

B. Each coupling size shall be determined based on the rated horsepower of the motor, speed of the shaft, and the load classification service factor. The CONTRACTOR shall have the equipment manufacturer select or recommend the size and type of coupling required to suit each specific application.

C. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, 2 sets of universal type couplings shall be provided.

D. Taper-Lock or equal bushings may be used to provide for easy installation and removal of shafts of various diameters.

2.4 SHAFTING

A. General: Equipment manufacturer shall be responsible for designing and manufacturing shafting to carry all loads applied to the shaft. Shafting shall be continuous between bearings and shall be sized to transmit the power required. Keyways shall be accurately cut in line. Shafting shall not be turned down at the ends to accommodate bearings or sprockets whose bore is less than the diameter of the shaft. Shafts shall rotate in the end bearings and shall be turned and polished, straight, and true.

B. Design Criteria: Shafts shall be designed to carry the steady state and transient loads suitable for unlimited number of load applications.

C. Materials: Shafting materials shall be compatible with the type of service and load transmitted. Environmental elements such as corrosive gases, moisture, and fluids shall be taken into consideration. Materials shall be as indicated unless furnished as part of an equipment assembly.

1. Low carbon cold-rolled steel shafting shall conform to ASTM A 108, Grade 1018.

2. Medium carbon cold-rolled shafting shall conform to ASTM A 108, Grade 1045.

3. Other grades of carbon steel alloys shall be suitable for service and load.

4. Corrosion-resistant shafting shall be stainless steel or Monel, whichever is most suitable for the intended service.

D. Differential Settlement: Where differential settlement between the driver and the driven equipment may occur, a shaft of sufficient length with 2 sets of universal type couplings shall be provided.

2.5 BEARINGS

A. General: Bearings shall conform to the standards of the American Bearing Manufacturers Association, Inc. (ABMA).

B. To assure satisfactory bearing application, fitting practice, mounting, lubrication, sealing, static rating, housing strength, and lubrication shall be considered in bearing selection.

C. Re-lubricatable type bearings shall be equipped with hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

D. Lubricated-for-life bearings shall be factory-lubricated with the manufacturer's recommended grease to insure maximum bearing life and best performance.

E. Anti-Friction Type Bearing Life: Except where otherwise indicated, bearings shall have a minimum L-10 life expectancy of 5 years or 20,000 hours, whichever occurs first. Where so indicated, bearings shall have a minimum rated L-10 life expectancy corresponding to the type of service, as follows:

Type of Service	**Design Life, years**	**L-10 Design Life, hours**
	(whichever comes first)	
8-hour shift	10	20,000
16-hour shift	10	40,000
Continuous	10	60,000

F. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as indicated or as recommended in the published standards of the manufacturer. Split-type housings may be used to facilitate installation, inspection, and disassembly.

G. Sleeve Type Bearings: Sleeve-type bearings shall have a cast iron or ductile iron housing and Babbitt or bronze liner. Bearing housing shall be bolted and doweled to the lower casing half. These housings shall be provided with cast iron caps bolted in place and the bearing end caps shall be bored to receive the bearing shells. Sleeve bearings shall be designed on the basis of the maximum allowable load permitted by the bearing manufacturer. If the sleeve bearing is connected to an equipment shaft with a coupling, the coupling transmitted thrust will be assumed to be the maximum motor or equipment

thrust. Lubricant, lubrication system, and cooling system shall be as recommended by the bearing manufacturer. In accordance with the Lead Reduction Act, sleeve bearings containing lead material exposed to drinking water shall not be acceptable.

2.6 PIPING CONNECTIONS

A. Pipe Hangers, Supports, and Guides: Pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment. Supports and hangers shall be in accordance with Section 43 10 52 - Pipe Supports.

B. Flanges and Pipe Threads: Flanges on equipment and appurtenances shall conform to ASME B16.1, Class 125, or B16.5, Class 150, unless otherwise indicated. Pipe threads shall be in accordance with ASME B1.20.1 and Section 43 10 50 - Piping, General.

C. Flexible Connectors: Flexible connectors shall be installed in piping connections to engines, blowers, compressors, and other vibrating equipment and in piping systems in accordance with the requirements of Section 43 10 50 – Piping, General. Flexible connectors shall be harnessed or otherwise anchored to prevent separation of the pipe where required by the installation.

D. Insulating Connections: Insulating bushings, unions, couplings, or flanges, as appropriate, shall be used in accordance with the requirements of the specifications.

2.7 GASKETS AND PACKINGS

A. Gaskets and packings shall be in accordance with the requirements of the specifications. Gaskets and packings in contact with drinking water shall be NSF 61 approved. Elastomeric materials in contact with water with chloramines, or water with ozone residual shall be made of Teflon or Viton-A, or equal.

B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron-type "V" packing shall be Garlock No. 432, John Crane Everseal, or equal.

C. Packing around rotating shafts (other than valve stems) shall be "O" rings, stuffing boxes, or mechanical seals, as recommended by the manufacturer and approved by the ENGINEER, in accordance with Section 43 20 00 - Pumps, General.

2.8 NAMEPLATES

A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

2.9 TOOLS AND SPARE PARTS

A. Tools: The CONTRACTOR shall furnish one complete set of special wrenches and other special tools necessary for the assembly, adjustment, and dismantling of the equipment. Tools shall be of best quality hardened steel forgings with bright finish. Wrench heads shall have work faces dressed to fit nuts. Tools shall be suitable for professional work and manufactured by Snap On, Crescent, Stanley, or equal. The set of tools shall be neatly mounted in a labeled toolbox of suitable design provided with a hinged cover.

B. Spare parts shall be furnished as indicated in the individual equipment sections. Spare parts shall be suitably packaged in a metal box and labeled with equipment numbers by means of stainless steel or solid plastic nametags attached to the box.

2.10 EQUIPMENT LUBRICANTS

A. The CONTRACTOR shall provide lubricants for equipment during shipping, storage, and prior to testing, in accordance with the manufacturer's recommendations. Lubricants that could come in contact with potable water shall be food grade lubricants. After successful initial testing, final testing, and satisfactory completion startup testing per Section 01 75 00 - Equipment Testing and Plant Startup, the CONTRACTOR shall conduct one complete lubricant change on equipment. In addition, the CONTRACTOR shall be responsible for the proper disposal of used lubricants. The OWNER will then be responsible for subsequent lubricant changes

PART 3 -- EXECUTION

3.1 SERVICES OF MANUFACTURER

A. Installation Supervision, Inspection, Startup, and Field Adjustment: An authorized, experienced, and competent service representative of the manufacturer shall visit the Site to perform the following:

1. Supervision of the installation of the equipment

2. Inspection, checking, and adjusting the equipment and approving its installation

3. Startup and field testing for proper operation, efficiency, and capacity

4. Performing field adjustments during the test period to ensure that the equipment installation and operation comply with requirements

5. Certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation.

6. Unless otherwise indicated, factory representative shall be present at the job site for the following number of days:

    a. Half a day per equipment for smaller than 500 horsepower.

    b. One day per equipment for 500 horsepower and larger.

B. Owner Staff Training

1. Owner staff training shall be in accordance with Section 01 79 00 – Owner Staff Training.

2. Unless otherwise indicated, a minimum of one day of training shall be provided for each type of equipment.

3.2 INSTALLATION

A. General: Equipment shall be installed in accordance with the manufacturer's written recommendations.

B. Alignment: Equipment shall be field tested to verify proper alignment.

3.3 PACKAGED EQUIPMENT

A. When any system is furnished as pre-packaged equipment, the CONTRACTOR shall coordinate space and structural requirements, clearances, utility connections, signals, and outputs with Subcontractors to avoid later change orders.

B. If the packaged system has any additional features (as safety interlocks, etc.) other than required by the Contract Documents, the CONTRACTOR shall coordinate such features with the ENGINEER and provide material and labor necessary for a complete installation as required by the manufacturer.

3.4 FIELD ASSEMBLY

A. Studs, cap screws, bolt and nuts used in field assembly shall be coated with Never Seize compound or equal.

3.5 WELDING

A. Welds shall be cleaned of weld-slag, splatter, etc. to provide a smooth surface.

3.6 FIELD TESTS

A. Where indicated by the individual equipment sections, equipment shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, or overheating of bearings or motor.

B. The following field testing shall be conducted:

1. Start equipment, check, and operate the equipment over its entire operating range. Vibration level shall be within the amplitude limits as indicated or as recommended by the reference applicable standards.

2. Obtain concurrent readings of motor voltage, amperage, capacity, vibration, and bearing temperatures.

3. Operate equipment indicated in Section 01 75 00 – Equipment Testing and Plant Startup.

C. The ENGINEER shall witness field-testing. The CONTRACTOR shall notify the ENGINEER of the test schedule 3 Days in advance.

D. In the event that any equipment fails to meet the test requirements, the equipment shall be modified and retested until it satisfies the requirement.

END OF SECTION

EXHIBIT D

Drawings

Stantec

CLACKAMAS WATER ENVIRONMENT SERVICES

Kellogg Creek Water Resource Recovery Facility (WRRF) Influent Pump 2 and 4 Replacement

ISSUED FOR CONSTRUCTION 2021.11.23

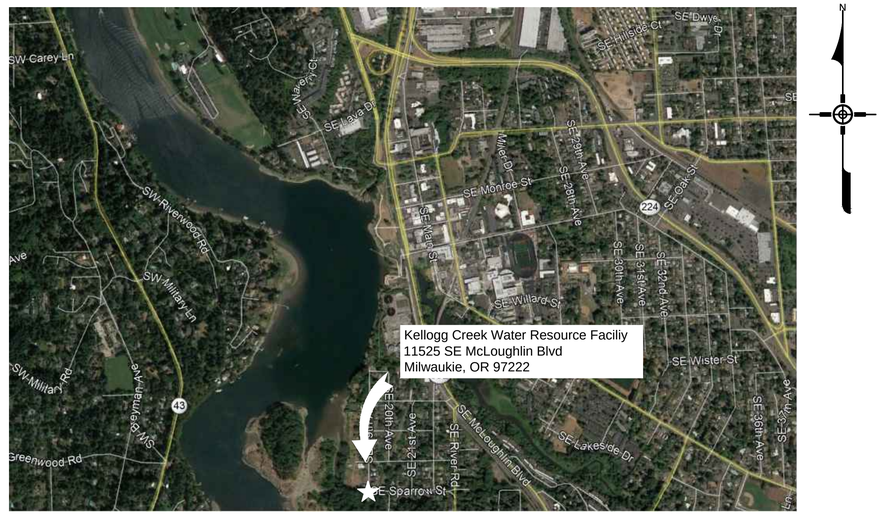
WES PROJECT NUMBER: 3690

STANTEC PROJECT NUMBER: 2002006172

REGISTERED PROFESSIONAL ENGINEER
58599
OREGON
JULY 21, 1998
HEATHER M. STEPHENS
EXPIRATION DATE: 6/30/22

LOCATION MAP

VICINITY MAP



LIST OF DRAWINGS

GENERAL

1G-001	COVER SHEET, LOCATION AND VICINITY
1G-002	LIST OF DRAWINGS, DESIGN CRITERIA AND STANDARD SYMBOLS
1G-003	ABBREVIATIONS
1G-004	PIPE SCHEDULE
1G-901	3D MODEL

INSTRUMENTATION

I-601	INFLUENT PUMPS P&ID
I-602	INFLUENT PUMPS EXISTING IO - I
I-603	INFLUENT PUMPS EXISTING IO - II
I-604	INFLUENT PUMPS EXISTING IO - III
I-605	INFLUENT PUMPS EXISTING IO - IV
I-606	INFLUENT PUMPS EXISTING IO - V

PROCESS MECHANICAL

D-001	GENERAL NOTES AND SYMBOLS
D-002	STANDARD DETAILS - I
D-003	STANDARD DETAILS - II
DD101	DEMOLITION PUMP STATION WET WELLS - PLANS
DD301	DEMOLITION PUMP STATION WET WELLS - SECTIONS - I
D-101	PUMP STATION WET WELL - PLANS
D-301	PUMP STATION WET WELL - SECTIONS - I
D-501	DETAILS

ELECTRICAL

E-001	SYMBOLS - I
E-002	SYMBOLS - II
E-003	ABBREVIATIONS AND GENERAL NOTES
E-004	STANDARD DETAILS - I
ED101	DEMOLITION PUMP STATION - WET WELL PLANS
ED301	DEMOLITION PUMP STATION - WET WELL SECTIONS - I
E-101	PUMP STATION - WET WELL PLANS
E-103	INFLUENT PUMP STATION - TOP PLAN
E-601	SCHEMATIC DIAGRAMS - I
E-602	SCHEMATIC DIAGRAMS - II
E-603	SINGLE LINE DIAGRAM AND CONDUIT RISER
E-901	PHOTOGRAPHS - I
E-902	PHOTOGRAPHS - II
E-903	PHOTOGRAPHS - III

DESIGN CRITERIA

CRITERIA	UNITS	VALUE
INFLUENT FLOWS		
DESIGN INFLOW	MGD	25
MINIMUM PUMPED FLOW	MGD	3
TOTAL PUMPING CAPACITY	MGD	40
PUMPS		
LARGE	NEW	2
SMALL	EXISTING	2
TYPE		SUBMERSIBLE FLYGT N-IMPELLER
MINIMUM SOLIDS TO PASS	INCH	4
SERVICE		3 DUTY, 1 STANDBY (DRY PIT)
CAPAPCITY	GPM	2 @ 14 MGD, NEW
		2 @ 6 MGD, EXISTING
FIRM SYSTEM CAPACITY	MGD	26
TDH AT DESIGN FLOW	FEET	46
MINIMUM TDH	FEET	33
DRIVE		VARIABLE SPEED (VFD)
SPEED RANGE	RPM	550 - 880
MOTOR SIZE	HP	170
TOTAL HP INSTALLED (WITH EXISTING PUMPS)	HP	460
FLOW METERING		
TYPE	EXISTING	MAGMETER
NUMBER	-	4
SIZE	INCH	24

GENERAL SYMBOLOGY

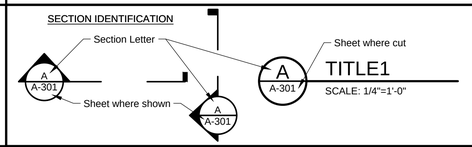
- NEW CONSTRUCTION
- EXISTING (SCREENED)
- FUTURE (PHANTOM)
- EXISTING TO BE REMOVED OR DEMOLISHED

MATERIAL SYMBOLOGY

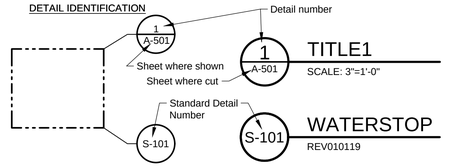
- CONCRETE (PLAN AND SECTION)
- GROUT OR SAND (PLAN AND SECTION)
- BRICK (PLAN AND SECTION)
- CMU (PLAN AND SECTION)
- STEEL/METAL/FRP (SMALL SCALE SECTION)
- CHECKER PLATE OR SOLID FRP GRATING (PLAN)
- CHECKER PLATE (SECTION)
- GRATING (PLAN)
- GRATING OR SOLID FRP GRATING (SECTION)
- SAFETY GRATING (PLAN)
- SAFETY GRATING (SECTION)
- RAILING (PLAN)
- FINISHED GRADE
- GRAVEL/DRAINROCK/AGGREGATE BASE

REFERENCE SYMBOLS

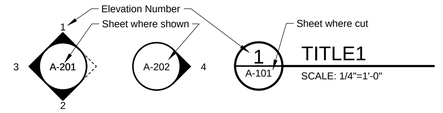
SECTION IDENTIFICATION



DETAIL IDENTIFICATION



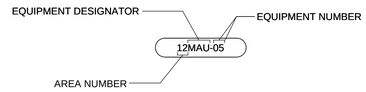
INTERIOR ELEVATION IDENTIFICATION



EXTERIOR ELEVATION IDENTIFICATION

EQUIPMENT IDENTIFICATION

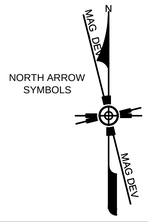
SEE EQUIPMENT SCHEDULE/SPECIFICATIONS



PLEASE NOTE:

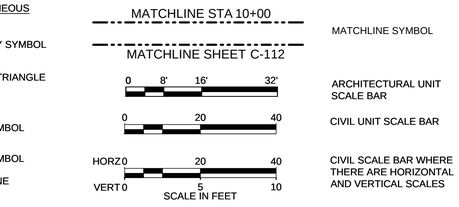
DISCIPLINE SPECIFIC SYMBOLS ARE SHOWN ON THE DISCIPLINE GENERAL DRAWINGS.

FOR WELDING SYMBOLS USE AMERICAN WELDING SOCIETY STANDARD SYMBOLS.



MISCELLANEOUS

- SHEET KEY SYMBOL
- REVISION TRIANGLE SYMBOL (1)
- BREAK SYMBOL
- ANGLE SYMBOL
- CENTERLINE SYMBOL



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CLACKAMAS WATER ENVIRONMENT SERVICES

Issued			
A	30% PROGRESS PRINTS	LS	HS
B	90% PROGRESS PRINTS	LS	HS
0	FOR CONSTRUCTION	LS	HS
Revision		By	Appd
		2021.05.24	2021.08.11
		YYYY.MM.DD	YYYY.MM.DD

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 58599 OREGON JULY 21, 1995 HEATHER M. STEPHENS

EXPIRATION DATE: 6/30/22

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES

KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT

Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172G-002

Scale: NO SCALE

REM	AO	GT	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
LIST OF DRAWINGS, DESIGN CRITERIA AND STANDARD SYMBOLS

Revision:

Drawing No.
G-002

ORIGINAL SHEET - ANSI D

A

A	AIR/ AMPERE
A/C	AIR CONDITIONING
A/R	AIR RELEASE
AASHTO	AMERICAN ASSOCIATION OF STATE HIGHWAY & TRANSPORTATION OFFICIALS
AB	ANCHOR BOLT
ABAN	ABANDON
ABND	ABANDONED
ABBR	ABBREVIATION
ABS	ABSOLUTE TEMPERATURE
AC	ACTIVATED CARBON/ ASPHALTIC CONC/ ALTERNATING CURRENT
ACI	AMERICAN CONCRETE INTERNATIONAL
ACOUS	ACOUSTIC/ ACOUSTICAL
ACP	ASBESTOS CEMENT PIPE/ ASPHALTIC CONCRETE PAVEMENT
ADD	ADDITIONAL
ADH	ADHESIVE
ADJ	ADJUSTABLE
AFF	ABOVE FINISHED FLOOR
AISC	AMERICAN INSTITUTE OF STEEL CONST
ALT	ALTERNATE
ALUM	ALUMINUM/ ALUM
AMB	AMBIENT
ANSI	AMERICAN NATIONAL STANDARDS INST
API	AMERICAN PETROLEUM INSTITUTE
APPD	APPROVED
APPROX	APPROXIMATE
APPURTS	APPURTENANCES
ARCH	ARCHITECTURE
ASME	AMERICAN SOCIETY OF MECHANICAL ENG
ASPH	ASPHALT
ASTM	AMERICAN SOCIETY FOR TEST & MATERIALS
AT	ACOUSTICAL TILE
ATM	ATMOSPHERE
AV/AR	AIR VACUUM AND AIR RELEASE VALVE
AVE	AVENUE
AWPA	AMERICAN WOOD PRESERVERS ASSOC
AWS	AMERICAN WELDING SOCIETY
AWWA	AMERICAN WATER WORKS ASSOCIATION

B

B&S	BELL AND SPIGOT
B/W	BACK OF WALL/ BACK OF WALK
BC	BEGIN CURVE/ BOLT CIRCLE/ BETWEEN CENTERS/ BACK OF CURVE
BCR	BEGIN CURB RETURN
BD	BOARD
BDRY	BOUNDARY
BF	BLIND FLANGE/ BOTTOM OF FOOTING
BFP	BACK FLOW PREVENTER
BFV	BUTTERFLY VALVE
BHP	BRAKE HORSEPOWER
BLDG	BUILDING
BLK	BLACK/ BLOCK
BLKG	BLOCKING
BLVD	BOULEVARD
BM	BEAM/ BENCH MARK
BO	BLOW-OFF ASSEMBLY
BOD	BIOCHEMICAL OXYGEN DEMAND
BOP	BOTTOM OF PIPE
BOT	BOTTOM
BPV	BACK PRESSURE VALVE
BRK	BRICK/ BREAK
BSMT	BASEMENT
BT	BOLT
BTU	BRITISH THERMAL UNIT
BV	BALL VALVE
BVC	BEGIN VERTICAL CURVE
BWV	BACK WATER VALVE

C

C	CENTIGRADE/ CHANNEL/ CEMENT
C&G	CURB AND GUTTER
CAB	CABINET/ CRUSHED AGGREGATE BASE
CAP	CAPACITY
CATS	CASING TEST STATION
CATV	CABLE TELEVISION
CB	CATCH BASIN/ CHALKBOARD/ CURB
CC	CLOSED CIRCUIT TV/ CENTER TO CENTER
CD	CEILING DIFFUSER/ CATALYTIC DISTRUCT
CEM	CEMENT
CF	CURB FACE/ CUBIC FOOT
CFH	CUBIC FEET PER HOUR
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
CHEM	CHEMICAL
CHG	CHANGE
CHKD	CHECKERED
CI	CAST IRON
CIP	CAST IRON PIPE/ CAST IN PLACE
CIPP	CAST IN PLACE PIPE
CJ	CONSTRUCTION JOINT
CL	CENTERLINE
CL2	CHLORINE
CLF	CHAIN LINK FENCE
CLG	CEILING
CLOS	CLOSET
CLR	CLEAR/ CLEARANCE
CMB	CRUSHED MISCELLANEOUS BASE
CMC	CEMENT MORTAR-COATED
CML	CEMENT MORTAR-LINED
CML&C	CEMENT MORTAR-LINED AND COATED
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CO	CLEANOUT
COL	COLUMN
COMM	COMMUNICATIONS CABLE
COMP	COMPRESSOR
CONC	CONCRETE/ CONCENTRIC
COND	CONDENSER/ CONDENSATE
CONN	CONNECTION
CONST	CONSTRUCT/ CONSTRUCTION
CONT	CONTINUED/ CONTINUOUS
CONTR	CONTRACTOR
COORD	COORDINATE
COR	CORNER
COTG	CLEANOUT TO GRADE
CPF	CHEMICAL POT FEEDER
CPLG	COUPLING
CPVC	CHLORINATED POLYVINYL CHLORIDE
CS	CAST STEEL
CSP	CORRUGATED STEEL PIPE
CSTS	CURRENT SPAN TEST STATION
CT	CERAMIC TILE
CTR	CENTER
CTS	CORROSION TEST STATION, CALCIUM THIOSULFATE
CTSK	COUNTERSUNK
CU	COPPER/ CUBIC
CULV	CULVERT
CV	CHECK VALVE
CW	CLARIFIED WATER
CY	CUBIC YARD
CYL	CYLINDER

D

d	PENNY
DAD	DOUBLE ACTING DOOR
DAFT	DISSOLVED AIR FLOTATION THICKENER
DB	DIRECT BURY
DBL	DOUBLE
DC	DIRECT CURRENT
DEG	DEGREE
DET	DETAIL
DF	DRINKING FOUNTAIN/ DOUGLAS FIR
DG	DOOR GRILL
DH	DOUBLE HUNG
DI	DUCTILE IRON
DIA	DIAMETER
DIAG	DIAGONAL
DIAPH	DIAPHRAGM
DIFF	DIFFUSER/ DIFFERENTIAL
DIP	DUCTILE IRON PIPE
DIR	DIRECTION
DISCH	DISCHARGE
DISP	DISPENSER
DL	DEAD LOAD
DMH	DROP MANHOLE
DN	DOWN
DO	DISSOLVED OXYGEN/ DITTO
DR	DOOR/ DRAIN
DS	DRENCH SHOWER AND EYE WASH
DT	DRAIN TILE
DWG	DRAWING
DWLS	DOWELS
DWY	DRIVEWAY

E

E	EAST
E/O	EAST OF
EA	EACH
EB	EXPANSION BOLT OR ANCHOR
EC	END CURVE
ECC	ECCENTRIC
ECR	END CURB RETURN
EF	EACH FACE/ EXHAUST FAN
EFF	EFFLUENT
EG	EXIST GRADE/ EDGE OF GUTTER/ EXHAUST GRILLE
EGL	ENERGY GRADE LINE
EL	ELEVATION
ELEC	ELECTRICAL/ ELECTRONIC
EN	EDGE NAILING
ENCL	ENCLOSURE
ENG	ENGINE
ENGR	ENGINEER
ENT	ENTRANCE
EP	EDGE OF PAVEMENT
EPT	ETHYLENE PROPYLENE
EQ	EQUAL
EQUIP	EQUIPMENT
ESMT	EASEMENT
ETB	EMULSION TREATED BASE
ETC	ET CETERA
EVAP	EVAPORATOR
EVC	END VERTICAL CURVE
EW	EACH WAY/ EYE WASH
EX	EXISTING
EXC	EXCAVATION
EXH	EXHAUST
EX-HY	EXTRA HEAVY
EXIST	EXISTING
EXP	EXPANSION
EXT	EXTERIOR/ EXTENSION
EXTR	EXTRUDED

F

F	FAHRENHEIT/ FINISH
F TO F	FACE TO FACE
F&C	FRAME AND COVER
F&I	FURNISH AND INSTALL
FA	FILTER AID POLYMER
FAB	FABRICATE/ FABRICATION/ FABRICATED
FAI	FRESH AIR INTAKE
FB	FLAT BAR/ FLOOR BEAM/ FIELD BOOK
FCO	FLOOR CLEANOUT
FD	FLOOR DRAIN
FDR	FEEDER
FE	FIRE EXTINGUISHER/ FINAL EFFLUENT
FEM	FEMALE (PIPE THREAD)
FF	FLAT FACE/ FAR FACE/ FINISHED FLOOR
FG	FINISHED GRADE
FH	FIRE HYDRANT/ FLAT HEAD
FIG	FIGURE
FIN	FINISHED
FIX	FIXTURE
FL	FLOWLINE/ FLOOR
FLEX	FLEXIBLE
FLG	FLANGE/ FLOORING
FLGD	FLANGED
FLOCC	FLOCCULATOR/ FLOCCULATION
FLR	FLOOR
FLSG	FLASHING
FM	FACTORY MUTUAL (LAB APPRVD)/ FORCE MAIN
FMH	FLEXIBLE METAL HOSE
FN	FIELD NAILING
FND	FOUNDATION
FOC	FACE OF CONCRETE/ FIBER OPTIC CABLE
FOM	FACE OF MASONRY
FOS	FACE OF STUDS
FOW	FACE OF WALL
FPC	FLEXIBLE PIPE COUPLING
FPM	FEET PER MINUTE
FPS	FEET PER SECOND
FPTS	FOREIGN PIPE TEST STATION
FR	FRAME
FRP	FIBERGLASS REINFORCED PLASTIC
FS	FINISHED SURFACE/ FAR SIDE/ FLOOR SINK / FORGED STEEL
FT	FEET/ FOOT
FTG	FOOTING
FUR	FURRING
FUT	FUTURE
FV	FIELD VERIFY
FWD	FORWARD

G

G	GAS
GA	GAGE / GAUGE
GAL	GALLON
GALV	GALVANIZED
GANC	GUY ANCHOR
GB	GRADE BREAK
GEN	GENERAL / GENERATOR
GFA	GROOVED FLANGE ADAPTER
GI	GALVANIZED IRON
GIP	GALVANIZED IRON PIPE
GL	GLASS / GROUND LINE / GRADE LINE
GLB	GLUE LAMINATED BEAM / GLULAM
GLV	GLOBE VALVE
GM	GAS METER
GP	GUY POLE
GPD	GALLONS PER DAY
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
GR	GRADE
GRD	GRADE / GROUND
GRTG	GRATING
GSP	GALVANIZED STEEL PIPE
GV	GATE VALVE
GYP	GYPSUM

H

H	HIGH / HEIGHT
H&V	HEATING AND VENTILATING
H/B	HOSE BIBB
HC	HOUSE CONNECTION
HDR	HEADER
HDW	HARDWARE
HDWL	HEADWALL
HEX	HEXAGONAL
Hg	MERCURY
HGL	HYDRAULIC GRADE LINE
HGR	HANGER
HM	HOLLOW METAL
HORZ	HORIZONTAL
HP	HIGH POINT / HORSE POWER / HIGH PRESSURE
HPG	HIGH PRESSURE GAS
HR	HEAT RETURN / HOUR
HSL	HORIZONTALLY SLOTTED
HSS	HOLLOW STRUCTURAL SECTION
HTG	HEATING
HTR	HEATER
HV	HORIZONTAL AND VERTICAL CONTROL POINT
HVAC	HEATING, VENTILATION AND AIR CONDITIONING
HW	HOT WATER / HEADWORK
HWD	HARDWOOD
HWL	HIGH WATER LEVEL
HWO	HANDWHEEL OPERATED
HYD	HYDRAULIC / HYDRANT

I

I/O	INPUT/OUTPUT
I&O	INSIDE AND OUTSIDE
IBC	INTERNATIONAL BUILDING CODE
ID	INSIDE DIAMETER
IF	INSIDE FACE
IJTS	INSULATING JOINT TEST STATION
IN	INCH
INCL	INCLUDE / INCLUDING
INFL	INFLUENT
INSL	INSULATION / INSULATING / INSULATED
INSP	INSPECTION
INST	INSTRUMENT
INT	INTERIOR
INV	INVERT
IP	IRON PIPE
IPS	IRON PIPE SIZE
IRRG	IRRIGATION

J

JAN	JANITOR
JC	JUNCTION CHAMBER
JCT	JUNCTION
JS	JUNCTION STRUCTURE
JSTS	JOISTS
JT	JOINT

K

k	KILO
K	KELVIN/ KARAT
kg	KILOGRAM
km	KILOMETER
kV	KILOVOLT
KVA	KILOVOLT AMPERE
kW	KILOWATT
kWh	KILOWATT HOUR

L

L	LITER/ LENGTH/ ANGLE
LAB	LABORATORY
LAM	LAMINATED
LAT	LATERAL
LAV	LAVATORY
LB	POUND
LCP	LOCAL CONTROL PANEL
LCS	LOCAL CONTROL STATION
LD	LOCAL DEPRESSION
LDG	LANDING
LEV	LEVEL
LF	LINEAR FOOT
LG	LENGTH/ LONG
LH	LAMP HOLE/ LEFT HAND
LL	LIVE LOAD
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LOC	LOCATION
LOL	LAYOUT LINE
LONG	LONGITUDINAL
LP	LOW POINT/ LOW PRESSURE/ LAMP POST
LPG	LIQUID PETROLEUM GAS
LT	LEFT/ LIGHT
LTS	LIME TREATED SOIL
LW	LOW WATER
LWL	LOW WATER LEVEL
LWR	LOWER

M

m	METER
M	MALE (PIPE THREAD)
mA	MILLIAMPS
MACH	MACHINE
MAG	MAGNETIC
MAINT	MAINTENANCE
MAN	MANUAL
MAS	MASONRY
MAT	MATERIAL
MAX	MAXIMUM
MB	MAIL BOX/ MACHINE BOLT
MCC	MOTOR CONTROL CENTER
MCR	MIDDLE OF CURB RETURN
MEAS	MEASURE
MECH	MECHANICAL
MED	MEDIUM
MEMB	MEMBER
MFR	MANUFACTURER
MFRD	MANUFACTURED
MGD	MILLION GALLONS PER DAY
MH	MANHOLE/ MAINTENANCE HOLE
MHT	MEAN HIGH TIDE
MHW	MEAN HIGH WATER
MI	MALLEABLE IRON/ MILE
MICRON	1/1,000,000 METER
MIL	MILITARY/ 1/1,000TH INCH
MIN	MINIMUM/ MINUTE
MIR	MIRROR
MISC	MISCELLANEOUS
MK	MARK
MLW	MEAN LOW WATER
mm	MILLIMETER
MO	MOTOR OPERATED/ MASONRY OPENING
MOD	MODEL
MON	MONUMENT
MOR	MORTAR
MS	MOP SINK
MSL	MEAN SEA LEVEL
MTC	MECHANICAL-TYPE COUPLING
MTD	MOUNTED
MTG	MOUNTING
MTL	METAL
MTR	MOTOR

N

N	NORTH
NaOCl	SODIUM HYPOCHLORITE
NaOH	SODIUM HYDROXIDE (CAUSTIC SODA)
NC	NORMALLY CLOSED
NEC	NATIONAL ELECTRICAL CODE
NEMA	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NF	NEAR FACE
NFPA	NATIONAL FIRE PROTECTION ASSOCIATION
NG	NATURAL GRADE/ NATURAL GAS
NIC	NOT IN CONTRACT
NO	NUMBER/ NORMALLY OPEN
NOM	NOMINAL
NPS	NOMINAL PIPE SIZE
NPT	NATIONAL PIPE THREAD
NRCP	NON-REINFORCED CONCRETE PIPE
NRS	NON-RISING STEM
NS	NEAR SIDE
NTS	NOT TO SCALE

O

O2	OXYGEN
O3	OZONE
OBJ	OBJECT
OC	ON CENTER/ OVER-CROSSING
OD	OUTSIDE DIAMETER/ OVERALL DIMENSION
OE	OUTER EDGE
OF	OVERFLOW/ OUTSIDE FACE
OFD	OVERFLOW DRAIN
OFF	OFFICE
OG	OFF GAS
OH	OVER HEAD
OHW	OVERHEAD WIRES
OPER	OPERATOR/ OPERATING
OPNG	OPENING
OPP	OPPOSITE
ORIG	ORIGINAL
OS&Y	OUTSIDE SCREW AND YOKE
OSA	OUTSIDE AIR
OSHA	OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION
OSS	OZONE SYSTEM SUPPLIER
OWG	OIL WATER GAS
OZ	OZONE, OUNCE
OZG	OZONE GENERATOR

P

P	POLE/ PAGE/ PIPE
P/S	POLE AND SHELF
PA	PLANTING AREA
PART	PARTITION
PAVMT	PAVEMENT
PB	POLYBUTYLENE/ PULL BOX
PC	POINT OF CURVATURE/ PRIMARY CLARIFIER/ PORTLAND CEMENT
PCC	PORTLAND CEMENT CONCRETE/ POINT OF COMPOUND CURVE
PCOTG	PRESSURE CLEANOUT TO GRADE
PCVC	POINT OF COMPOUND VERTICAL CURVE
PE	PLANT EFFLUENT/ POLYETHYLENE/ POLYELECTROLYTE POLYMER
PG	PRESSURE GAGE
PGE	PORTLAND GENERAL ELECTRIC
pH	RECIPROCAL LOG OF HYDROGEN ION CONCENTRATION
PI	PLANT INFLUENT/ POINT OF INTERSECTION
PK	PARKING
PL	PLATE/ PROPERTY LINE/ PLACE
PLAS	PLASTER/ PLASTIC
PLT	PLANT
PLWD	PLYWOOD
PM	PRESSED METAL

P CONT'D

PNEU	PNEUMATIC
PNL	PANEL
POB	POINT OF BEGINNING
POC	POINT OF CONNECTION
POT	POINT OF TANGENT
PP	POWER POLE/ POLYPROPYLENE
PPD	POUNDS PER DAY
PPH	POUNDS PER HOUR
PPM	POUNDS PER MINUTE / PARTS PER MILLION
PR	PAIR
PRC	POINT OF REVERSE CURVE
PRCT	PRECAST
PREFAB	PREFABRICATED
PRESS	PRESSURE
PROF	PROFILE
PRV	PRESSURE REGULATING, RELIEF OR REDUCING VALVE
PRVC	POINT OF REVERSE VERTICAL CURVE
PS	PRESSURE SWITCH
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSIA	POUNDS PER SQUARE INCH ABSOLUTE
PSIG	POUNDS PER SQUARE INCH GAUGE
PSU	POWER SUPPLY UNIT
PT	POINT OF TANGENCY/ PAINT/ PRESSURE
PTFE	POLYTETRAFLUOROETHYLENE (TEFLON)
PV	PLUG VALVE
PVC	POLYVINYL CHLORIDE
PVDF	POLYVINYLIDENE FLUORIDE (KYNAR)
PW	POTABLE WATER

Q

QT	QUARRY TILE
QTY	QUANTITY
QUAD	QUADRANGLE/ QUADRANT

R

R	RADIUS/ RISER / RATE OF SLOPE
R&O	ROCK AND OIL
R/W	RIGHT OF WAY
RAC	RECYCLED ASPHALT CONCRETE
RAG	RETURN AIR GRILLE
RAP	RECLAIMED ASPHALT PAVEMENT
RAS	RETURN ACTIVATED SLUDGE
RC	REINFORCED CONCRETE
RCP	REINFORCED CONCRETE PIPE
RD	ROAD/ ROOF DRAIN/ ROUND
RED	REDUCER/ REDUCING
REF	REFERENCE/ REFER/ REFRIGERATOR
REG	REGULATING
REINF	REINFORCE/ REINFORCED
REQD	REQUIRED
RESIL	RESILIENT
RET	RETAINING/ RETURN
REV	REVISION
REW	RECLAIMED WATER
RF	ROOF/ RAISED FOUNDATION/ ROUGH FACE
RFG	ROOFING
RGE	REGISTERED GEOTECHNICAL ENGINEER
RH	REDHEAD / RIGHT HAND
RM	ROOM
RO	ROUGH OPENING
RPM	REVOLUTIONS PER MINUTE
RR	RAILROAD
RS	RISING STEM
RSL	RAW SLUDGE
RT	RIGHT
RTP	REINFORCED THERMOSETTING PLASTIC
RTU	REMOTE TERMINAL UNIT
RW	REDWOOD
RWL	RAINWATER LEADER

S

S	SOUTH/SCUM/SINK/SECOND/SLOPE
S/O	SOUTH OF
SA	SAMPLE
SAN	SANITARY
SBR	STYRENE BUTADIENE (RUBBER)
SC	SECONDARY CLARIFIER
SCCP	STEEL CYLINDER CONCRETE PIPE
SCD	SCREWED
SCFM	STANDARD CUBIC FEET PER MINUTE
SCH	SCHEDULE
SD	SANITARY DRAIN/ SMOKE DETECTOR
SDR	STANDARD THERMOPLASTIC PIPE DIMENSION RATIO/STORM DRAIN
SEC	SECONDARY/ SECTION
SER	SERIES
SETT	SETTING
SF	SQUARE FOOT
SH	SHOWER
SHELV	SHELVING
SHT	SHEET
SHTG	SHEATHING
SIM	SIMILAR
SL	SLUDGE
SLDG	SLIDING
SLG	SLUICE GATE
SOG	SLAB ON GRADE
SOLN	SOLUTION
SP	STATIC PRESSURE/ SPARE CHEMICAL
SPEC	SPECIFICATION
SPK	SPIKE
SQ	SQUARE
SS	STAINLESS STEEL/ SANITARY SEWER/ SERVICE SINK
SSB	SELECT SUB-BASE
SSPWC	STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION
SSU	SECOND'S SAYBOLT UNIVERSAL
ST	STREET/ STATE
STA	STATION
STC	SLEEVE-TYPE COUPLING
STD	STANDARD
STK	STAKE
STL	STEEL
STM	STEAM
STR	STRAIGHT/ STRUCTURAL
SU	STEAM LINE
SUCT	SUCTION
SV	SOLENOID VALVE
SW	SIDEWALK
SWD	SIDEWALK DRAIN
SWGR	SWITCHGEAR
SWR	SIDEWALL REGISTER
SY	SQUARE YARD
SYM	SYMMETRICAL/ SYMBOL
SYS	SYSTEM

T

T	THERMOSTAT/ TREAD OF STAIR/ TANGENT
T&B	TOP AND BOTTOM
T&G	TONGUE AND GROOVE
TAN	TANGENT
TB	TACK BOARD
TBE	THREAD BOTH ENDS
TBM	TEMPORARY BENCH MARK
TC	TOP OF CURB
TCV	TEMPERATURE CONTROL VALVE
TEL	TELEPHONE
TEMP	TEMPERATURE/ TEMPORARY
TF	TOP OF FOOTING
TH	TEST HOLE
THK	THICK/ THICKNESS
THR	THREADED
THR'D	THREADED
TK	TANK/ TACK
TL	TRAVERSE LINE
TOC	TOP OF CONCRETE
TOE	THREAD ONE END
TOL	TOILET
TOM	TOP OF MASONRY
TOP	TOP OF PIPE
TOPO	TOPOGRAPHIC
TOS	TOP OF STEEL
TOW	TOP OF WALL
TP	TELEPHONE POLE
TR	TRACT
TRANS	TRANSMITTER/ TRANSITION /TRANSMISSION
TS	TRAFFIC SIGNAL
TSB	TOP SET BASE
TSC	TRAFFIC SIGNAL CONDUIT
TV	THERMOSTATIC VALVE/ TELEVISION
TW	THERMOMETER WELL /TRAVELED WAY
TYP	TYPICAL

U

UB	UNION BONNET
UBC	UNIFORM BUILDING CODE
UC	UNDER-CROSSING
UG	UNDERGROUND
UGC	UNDERGROUND CONDUIT
UH	UNIT HEATER
UL	UNDERWRITERS LABORATORIES
UNID	UNIDENTIFIED
UNO	UNLESS NOTED OTHERWISE
UOI	UNLESS OTHERWISE INDICATED
UPS	UNINTERRUPTABLE POWER SUPPLY
UR	URINAL
USA	UNDERGROUND SERVICE ALERT
USGS	UNITED STATES GEOLOGICAL SURVEY
UV	ULTRAVIOLET
UW	UTILITY WATER

V

V	VALVE/ VERTICAL/ VENT/ VOLT/ VOLUME
VAC	VACUUM
VAR	VARIES/ VARIABLE
VB	VALVE BOX
VC	VERTICAL CURVE
VCP	VITRIFIED CLAY PIPE
VERT	VERTICAL
VOL	VOLUME
VPI	VERTICAL POINT OF INTERSECTION
VSL	VERTICALLY SLOTTED
VTC	VENT TO CEILING
VTR	VENT THROUGH ROOF
VWC	VINYL WALL COVERING
VWM	VERIFY WITH MANUFACTURE

W

W	WEST/ WASTE/ WIDTH/ WIDE FLANGE/ WATER
W/	WITH
W/O	WEST OF / WITHOUT
WC	WATER COLUMN / WATER CLOSET
WCO	WALL CLEANOUT
WD	WOOD
WDW	WINDOW
WES	WATER ENVIRONMENT SERVICE
WH	WATER HEATER
WI	WROUGHT IRON
WM	WATER METER
WOG	WATER, OIL, OR GAS
WP	WATERPROOFING/ WORKING PRESSURE/ WORK POINT
WPJ	WEAKEN PLANE JOINT
WRRF	WATER RESOURCE RECOVERY FACILITY
WS	WATER SURFACE
WSTP	WATERSTOP
WT	WEIGHT
WWF	WELDED WIRE FABRIC
WWP	WATER WORKING PRESSURE

X

XCONN	CROSS CONNECTION
XS	EXTRA STRONG
XSEC	CROSS SECTION
XXS	DOUBLE EXTRA STRONG

Y

YD	YARD
YR	YEAR

Z

Z	ZERO/ ZONE
ZN	ZINC
#	POUND
&	AND
@	AT

FOR ADDITIONAL ABBREVIATIONS SEE:

GENERAL: PIPING SCHEDULES (MATERIAL AND FLUID)
ELECTRICAL: GENERAL ELECTRICAL SHEETS

OTHER ABBREVIATIONS CONFORM TO ANSI STANDARD ABBREVIATIONS Z32.2.3

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0	FOR CONSTRUCTION	LS	HS	2021.11.23
B	90% PROGRESS PRINTS	LS	HS	2021.08.11
A	30% PROGRESS PRINTS	LS	HS	2021.05.24

Issued

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 58599 OREGON JULY 21, 1989 HEATHER M. STEPHENS

EXPIRATION DATE: 12/31/22

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172
File Name: 06172G-003
Scale: NO SCALE

REM	AO	GT	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
ABBREVIATIONS

Revision:

Drawing No.
G-003

ORIGINAL SHEET - ANSI D

FLUID ABBREVIATION	FUNCTION THIS LIST INCLUDES SOME LINES NOT USED IN THIS PROJECT	PIPING MATERIALS (SEE GENERAL NOTES AT THE RIGHT AND PIPE MATERIAL SHEET)				FIELD TEST REQUIREMENTS Ⓑ Ⓒ		
		EXPOSED PIPING Ⓗ		BURIED PIPING		MINIMUM TEST PRESSURE (PSI)	TEST MEDIUM	LEAKAGE ALLOWANCE Ⓐ
		4" DIA AND SMALLER	6" DIA AND LARGER	4" DIA AND SMALLER	6" DIA AND LARGER			
DR	DRAIN	CU01, PV01, DI02	CU01, PV01, DI02, CS08	CU01, PV01, DI02	CU01, PV01, DI02, CS08	50	WATER	(A)
IA	INSTRUMENT AIR	SS01	--	--	--	125	AIR	(A)(D)
RS	RAW SEWAGE	--	DI02, CS02, CS08	--	DI02, CS01, CS02, CS08	Ⓔ	WATER	(A)
UW	UTILITY WATER (NON-POTABLE WATER)	CS02, DI01, PV01, CU01	CS02, CS08, DI01, PV01	--	--	125	WATER	CS02,DI01, CU01(A) PV03,PV04(B)
VT	VENT	CS01	CS01	--	--	--	--	--

PIPING MATERIAL SCHEDULE Ⓒ

GROUP NO	PIPE Ⓚ	FITTINGS	VALVES, 6" AND SMALLER Ⓘ Ⓙ
CS01	STEEL, ASTM A53, SCH 40, WELDED, BLACK.	2 1/2" AND SMALLER, MALLEABLE IRON, ASME B16.3, THREADED, BANDED, BLACK, 150 PSI OR STEEL, ASME B16.9, BUTT-WELDED. 3" AND LARGER, CAST IRON, ASME B16.1, 125 PSI FLANGED OR MECHANICAL COUPLING.	BRONZE, THREADED, GATE: CRANE 428 UB OR STOCKHAM B-105. GLOBE: STOCKHAM B-37. CHECK: CRANE 37 OR STOCKHAM B-319Y. IRON PLUG VALVE: NORDSTROM FIG 142 OR 143. ECC PLUG: DEZURIK PEC, CAST IRON OR MILLIKEN 603E. BALL: JAMESBURY FIG 351 OR WATTS #B-6080. LUBRICATED PLUG VALVE (FOR CONDENSATE ONLY): NORDSTROM FIG 114 OR 115.
CS02	STEEL, ASTM A53, SCH 40, WELDED, LINING PER 09 96 00 SYSTEM 106 - FM-8	2 1/2" AND SMALLER, MALLEABLE IRON, ASME B16.3, THREADED, BANDED, 150 PSI. 3" AND LARGER, CAST IRON, ASME B16.1, 125 PSI FLANGED OR MECHANICAL COUPLING, LINING PER 09 96 00 SYSTEM 106 - FM-8	2 1/2" AND SMALLER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED: DEZURIK PEC, CAST IRON, OR MILLIKEN 603E. BALL: JAMESBURY FIG 351 OR WATTS #B-6080. 3" AND LARGER, ECCENTRIC PLUG, SYNTHETIC RUBBER FACED: DEZURIK PEC, CAST IRON, OR MILLIKEN 601. GATE: AWWA C500. BUTTERFLY: AWWA, FLANGED.
CS08	WELDED STEEL, AWWA C200, LINED.	WELDED STEEL, AWWA C208, LINED, FABRICATED.	AS INDICATED ON DRAWINGS.
CU01	COPPER, ASTM B88, TYPE K, SOFT TEMPERED WHERE BURIED, HARD TEMPERED WHERE EXPOSED.	WROUGHT COPPER OR CAST BRONZE, ASME B16.22, SILVER SOLDER JOINT, 150 PSI, OR COMPRESSION FITTINGS.	BRONZE, SILVER SOLDER JOINT, GLOBE: CRANE #1310 OR STOCKHAM B-14T. CHECK: CRANE #1342 OR 36, OR STOCKHAM B-309Y OR B-345. GATE: CRANE #426 OR STOCKHAM B-104 OR B-105.
DI01	DUCTILE IRON, ANSI A21.51, (AWWA C151), ENDS BELL AND SPIGOT, MECHANICAL JOINTS OR 125 PSI FLANGED. (TYPICAL SERVICE - WATER LINES).	DUCTILE IRON AWWA C110, BELL AND SPIGOT JOINTS (RESTRAINED OR NON-RESTRAINED), MECHANICAL COUPLINGS, ASME B16.1 FLANGES, OR MECHANICAL JOINTS.	GATE: AWWA C500, O-RING SEALS, MECHANICAL JOINT ENDS, CLOW F-5065. BUTTERFLY: AWWA. ECC PLUG DEZURIK PEC, CAST IRON OR MILLIKEN 603E. BALL: PRATT OR APCO-WILLAMETTE.
DI02	DUCTILE IRON, ANSI A21.51, (AWWA C151), ENDS BELL AND SPIGOT, MECHANICAL JOINTS OR 125 PSI FLANGED. (TYPICAL SERVICE - SLUDGE AND SEWAGE LINES).	DUCTILE IRON AWWA C110, BELL AND SPIGOT JOINTS (RESTRAINED OR NON-RESTRAINED), MECHANICAL COUPLINGS, ASME B16.1 FLANGES, OR MECHANICAL JOINTS.	ECC PLUG, SYNTHETIC RUBBER FACED: DEZURIK PEC, CAST IRON OR MILLIKEN 601. SWING TYPE CHECK: CRANE #383 OR POWELL FIG 559. BALL: PRATT OR APCO-WILLAMETTE.
PV01	POLYVINYL CHLORIDE (PVC), ASTM D1785, SCH 80, TYPE I.	PVC, SCH 80, TYPE I, SOCKET SOLVENT WELD JOINTS, ASTM D2467. SOLVENT SHALL BE COMPATIBLE WITH FLUID SERVICE.	PVC, BALL, DIAPHRAGM, BUTTERFLY, OR LIFT CHECK: NIBCO/CHEMTROL, MCCANNA-MARPAC, OR GEORGE FISCHER SLOANE.
SS01	STAINLESS STEEL, TYPE 316L, ASTM A312, SCH 40S.	STAINLESS STEEL, TYPE 316L, THREADED, WELDED SLIP-ON FLANGE ASME B16.3, OR SOCKET WELDED FITTINGS SCH 40S.	STAINLESS STEEL, TYPE 316, BALL, FLANGED: CONTROMATICS SERIES 2801 OR JAMESBURY SERIES 7150. CHECK: LADISH 5275 OR CRANE FIG 377 OR AS SHOWN ON DRAWINGS.

GENERAL SHEET NOTES

1. ALTHOUGH SEVERAL PIPE MATERIAL GROUPS MAY BE LISTED ON THIS SHEET FOR A GIVEN FLUID SERVICE, CONTRACTOR SHALL PROVIDE ONLY THE PIPE MATERIAL GROUP SHOWN ON THE DRAWINGS AND SPECIFIED FOR THAT FLUID SERVICE.
2. CHANGE IN PIPING MATERIAL GROUP NUMBER IS INDICATED THUS: ——◆

SHEET KEYNOTES

A. LEAKAGE ALLOWANCE IS AS FOLLOWS:
(a) PIPES SO DESIGNATED SHALL SHOW ZERO LEAKAGE.

B. FOR FIELD TEST PROCEDURES AND ADDITIONAL TEST REQUIREMENTS, SEE PIPING SECTION OF SPECIFICATIONS.

C. NO SUBSTITUTIONS UNLESS ACCEPTED BY THE ENGINEER PER THE SPECIFICATIONS.

D. NOT USED.

E. STATIC WATER TEST WITH SURFACE 5 FEET ABOVE HIGH POINT OF PIPE.

F. NOT USED.

G. NOT USED.

H. EXPOSED PIPING SHALL BE PAINTED IN ACCORDANCE WITH SPECIFICATIONS. COLORS TO BE SELECTED BY ENGINEER.

I. PROPRIETARY NAMES HAVE BEEN QUOTED FOR IDENTIFICATION PURPOSES ONLY. SUBSTITUTIONS WILL BE PERMITTED SUBJECT TO PROVISIONS OF THE SPECIFICATIONS.

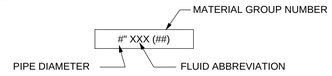
J. FOR VALVES 8" AND LARGER, SEE VALVE SCHEDULE. FOR SPECIAL VALVES, SEE SPECIFICATIONS. FOR PIPE LINING AND COATING, SEE SPECIFICATIONS.

K. PIPE MATERIALS SHALL BE PER THE REFERENCE STANDARDS AS MODIFIED BY THE CONTRACT SPECIFICATIONS. FOR PIPE LINING AND COATING, SEE SPECIFICATIONS.

LIST OF SAMPLE LINES

PIPE DESIGNATION	SAMPLE POINT

TYPICAL PIPE DESIGNATION:



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CLACKAMAS WATER ENVIRONMENT SERVICES

Issued	By		Appd		YYYY.MM.DD
A	LS	30% PROGRESS PRINTS	HS	HS	2021.05.24
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0	LS	FOR CONSTRUCTION	HS	HS	2021.11.23
Revision	By		Appd		YYYY.MM.DD

Permit/Seal

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172
File Name: 06172G-004

Scale: NO SCALE

REM	AO	GT	2021.11.23
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Title
PIPE SCHEDULE AND DESIGN CRITERIA

Revision:

Drawing No.
G-004

ORIGINAL SHEET - ANSI D

1 2 3 4 5

D C B A

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CLACKAMAS WATER ENVIRONMENT SERVICES

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Revision		By	Appd	YYYY.MM.DD

B	90% PROGRESS PRINTS	LS	HS	2021.08.11
A	30% PROGRESS PRINTS	LS	HS	2021.05.24
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Permit/Seal

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES

KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT

Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172G-901

Scale: NO SCALE

MT	LS	GT	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
3D MODEL

Revision:

Drawing No.
G-901

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ORIGINAL SHEET - ANSI D

SCADA

TYP P2 AND P4

YI 1124A	YI 1124B	YA 1124A	YC 1124	II 1124	SI 1124	SC 1124
REM	RNG	FAIL	RUN	CURR	FRQ	SPD

PLC 1 - IPS

TYP P2 AND P4

YI 1124A	YI 1124B	YA 1124A	YC 1124	SI 1124	SI 1124	SC 1124

ETHERNET TO PLC1 PANEL

VFD TYP P2 AND P4

HIM

FLYGT MAS811 BASE UNIT

PWR RNG FLT

RESET HOA SHUTDOWN

FLYGT MAS801 CENTRAL UNIT

HIM

DEVICENET

DEVICENET TO NEXT FLYGT BASE UNIT

FLYGT PEM

TEMP LEAK

TSH 1124 YS 1124

PLC 1 - IPS

SEAL WATER TYP 1 OF 2

AUTO RNG RUN

YI 1181 YI 1181 YC 1181

PSL 1180

FSL 1124

TYP P2 AND P4

FI 1004

PUMP 4 FLOW RATE

PUMP 3 FLOW RATE

FI 1003

PUMP 2 FLOW RATE

FI 1002

PUMP 1 FLOW RATE

FI 1001

LIT 1000

SCADA

1000 FI TOTAL FLOW RATE

1000 FQ TOTAL FLOW QUAN

FI 1004 FI 1003 FI 1002 FI 1001

TYP P1 AND P3

YI 1121	YI 1121	YA 1121	YA 1121	YC 1121	II 1121	SI 1121	SC 1121	YA 1121
AUTO	RNG	FAIL	VIB	RUN	CURR	FREQ	SPEED	

TYP P1 AND P3

YI 1121	YI 1121	YA 1121	YA 1121	YC 1121	SI 1121	SI 1121	SC 1121	YA 1124

PLC 1-IPS

CHANGE OF MATERIAL

M PI 16x24 (CS02) 1"

20" RS (CS02)

16" RS (CS02)

24" RS (CS08)

RAW SEWAGE PUMP NO. 4

110-1124

AI FLOW

HK 114 OSC

120V FIT 1004 FE 1004 M 480V

FM

24" RS

KNIFE GATE VALVE NO. 4

FV-114

KNIFE GATE VALVE NO. 4 MOTOR OPERATOR

MOP-114

CHANNEL INFLUENT SCREENING HEADWORKS

RAW SEWAGE PUMP NO. 3

110-1123

TSH 1123 PI M VSH 1123 PI

10"x14"

14" RS

AI FLOW

HK 113 OSC

120V FIT 1103 FE 1103 M 480V

FM

14"x24"

3" V

24" RS

LIT 1000

30" RS 20" RS

STRAIGHTENING VANE

2"

14" RS 10" RS

10"x14"

48" RS

PLANT INFLUENT

STRAIGHTENING VANE 20" RS (CS02)

2"

30" RS 20" RS

14" RS

10"x14"

INFLUENT PUMPING STATION WET WELL

FLYGT PEM

TEMP LEAK

TSH 1122 YS 1122

110-1122 RAW SEWAGE PUMP NO. 2

110-1122

CHANGE OF MATERIAL

M PI 16x24 (CS02) 1"

16" RS (CS02)

24" RS (CS08)

AI FLOW

112 HK OSC

120V FIT 1002 FE 1002 M 480V

FM

24" RS

3" V

VFD TYP P1 AND P3

HIM

RNG

HOA

TO BAR SCREENS

RAW SEWAGE PUMP NO. 1

110-1121

TSH 1121 PI M VSH 1121 PI

10" RS

10"x14"

14" RS

AI FLOW

HK 111 OSC

120V FIT 1101 FE 1101 M 480V

FM

14"x24"

24" RS

KNIFE GATE VALVE NO. 1, 2, 3, 4

530-1121
530-1122
530-1123
530-1124

KNIFE GATE VALVE NO. 1, 2, 3, 4 MOTOR OPERATOR

ZZ-1121
ZZ-1122
ZZ-1123
ZZ-1124

SEAL WATER PUMP NO. 1

110-1181

SEAL WATER PUMP NO. 2

110-1182

M 1 1/4" SW

DPI 1100 PSL 1180

3/4" W3

C

1/2" W3-TYP

SEAL WATER

1 1/4" W3

1 1/4" W3

100 PSIG

SEAL WATER SYSTEM ABANDONED IN PLACE

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CLACKAMAS WATER ENVIRONMENT SERVICES

Issued	By	Appd	YYYY.MM.DD
0 FOR CONSTRUCTION	LS	HS	2021.11.23
A 30% PROGRESS PRINTS	LS	HS	2021.05.24
B 90% PROGRESS PRINTS	LS	HS	2021.08.11

REGISTERED PROFESSIONAL ENGINEER
89440PE
OREGON
DEC 17, 2014
CARL M SERPA

EXPIRES: 06/30/2022

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES

KELLOGG CREEK WATER RESOURCE RECOVER FACILITY INFLUENT PUMPS

CLACKAMAS COUNTY, OREGON

Project No.: 2002006172

File Name: I601 P&ID

Scale: NO SCALE

CMS	CMS	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
INFLUENT PUMPS
P&ID

Revision:

Drawing No.
I-601

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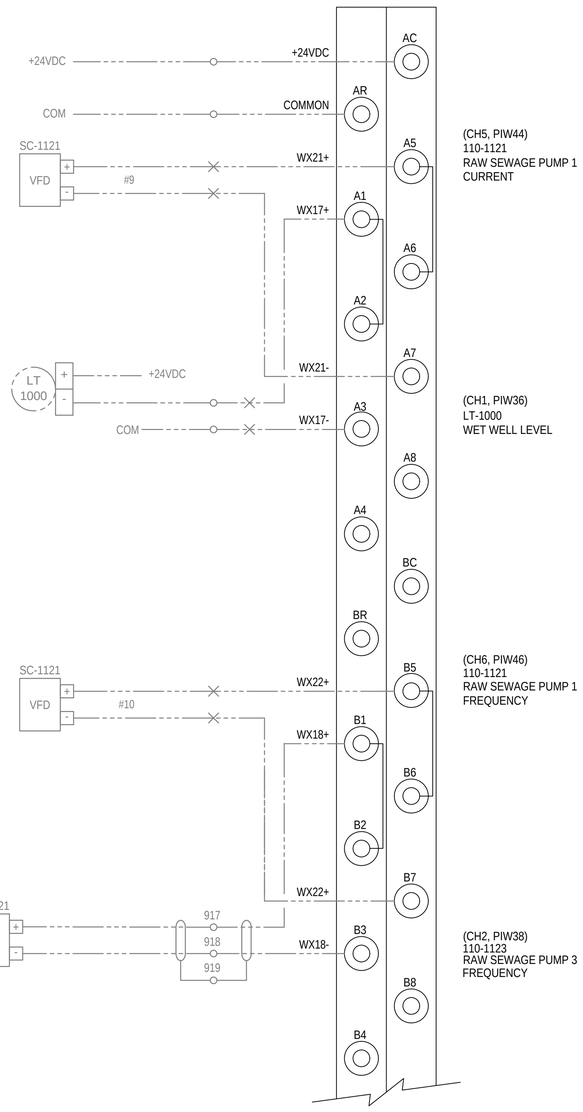
2021.10.22 10:38:20 AM

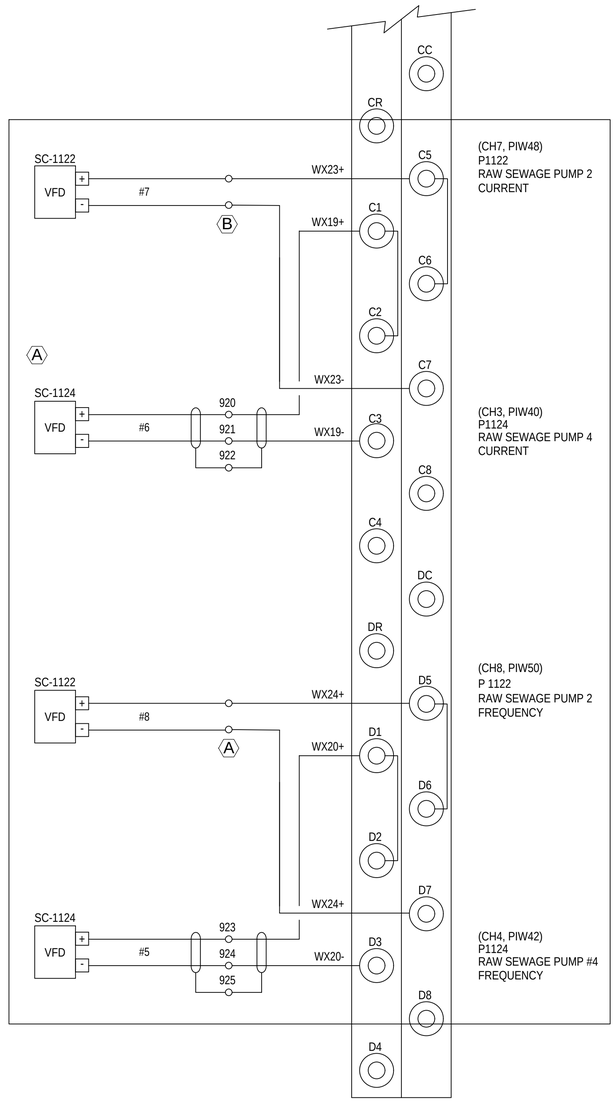
ORIGINAL SHEET - ANSI D

SHEET KEYNOTES

A. USE EXISTING WIRES SHOWN HERE FOR PUMP 2 AND PUMP 4 STATUS SIGNALS. RE-TERMINATE EXISTING WIRES ON NEW VFD'S.

B. THESE EXISTING TERMINALS ARE NOT NUMBERED. TERMINALS ARE LOCATED IN LOWER RIGHT CORNER OF PLC1 PANEL. THER TERMINAL STRIP IS LABELED "PUMP 2".





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CLACKAMAS WATER ENVIRONMENT SERVICES

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0 FOR CONSTRUCTION	LS	HS	2021.11.23

Revision

REGISTERED PROFESSIONAL ENGINEER
89440PE
OREGON
DEC 17, 2014
CARL M SERPA

EXPIRES: 06/30/2022

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES

KELLOGG CREEK WATER RESOURCE RECOVER FACILITY INFLUENT PUMPS

CLACKAMAS COUNTY, OREGON

Project No.: 2002006172

File Name: I602 IO SHEET 1

Scale: NO SCALE

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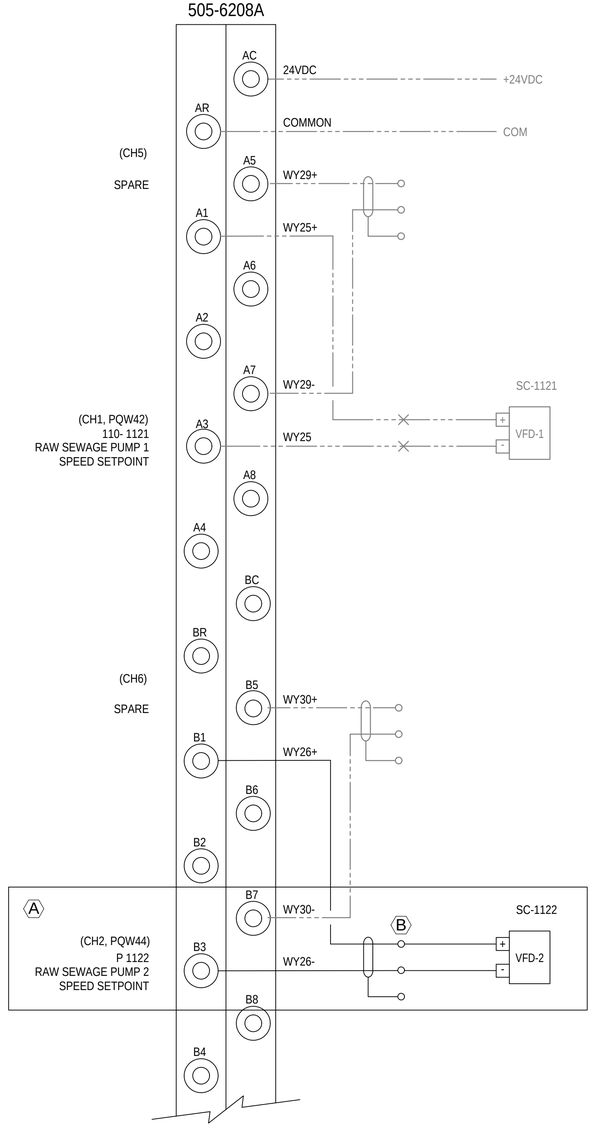
CMS	CMS	JCD	2021.11.23

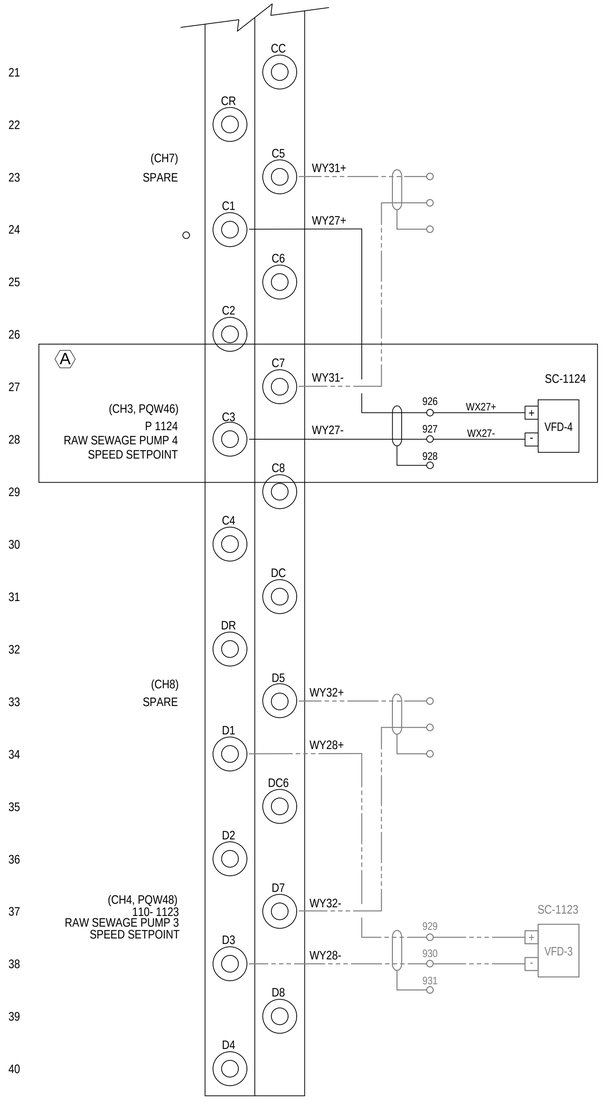
Title
INFLUENT PUMPS
EXISTING IO - 1

Revision:

Drawing No.
I-602

ORIGINAL SHEET - ANSI D





SHEET KEYNOTES

A. USE EXISTING WIRES SHOWN HERE FOR PUMP 2 AND PUMP 4 STATUS SIGNALS. RE-TERMINATE EXISTING WIRES ON NEW VFD'S.

B. THESE EXISTING TERMINALS ARE NOT NUMBERED. TERMINALS ARE LOCATED IN LOWER RIGHT CORNER OF PLC1 PANEL. THER TERMINAL STRIP IS LABELED "PUMP 2".

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CLACKAMAS WATER ENVIRONMENT SERVICES

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Revision

REGISTERED PROFESSIONAL ENGINEER
89440PE
OREGON
DEC 17, 2014
CARL M SERPA

EXPIRES: 06/30/2022

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES

KELLOGG CREEK WATER RESOURCE RECOVER FACILITY INFLUENT PUMPS
CLACKAMAS COUNTY, OREGON

Project No.: 2002006172

File Name: I602 IO SHEET 2

Scale: NO SCALE

Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
CMS	CMS	JCD	2021.11.23

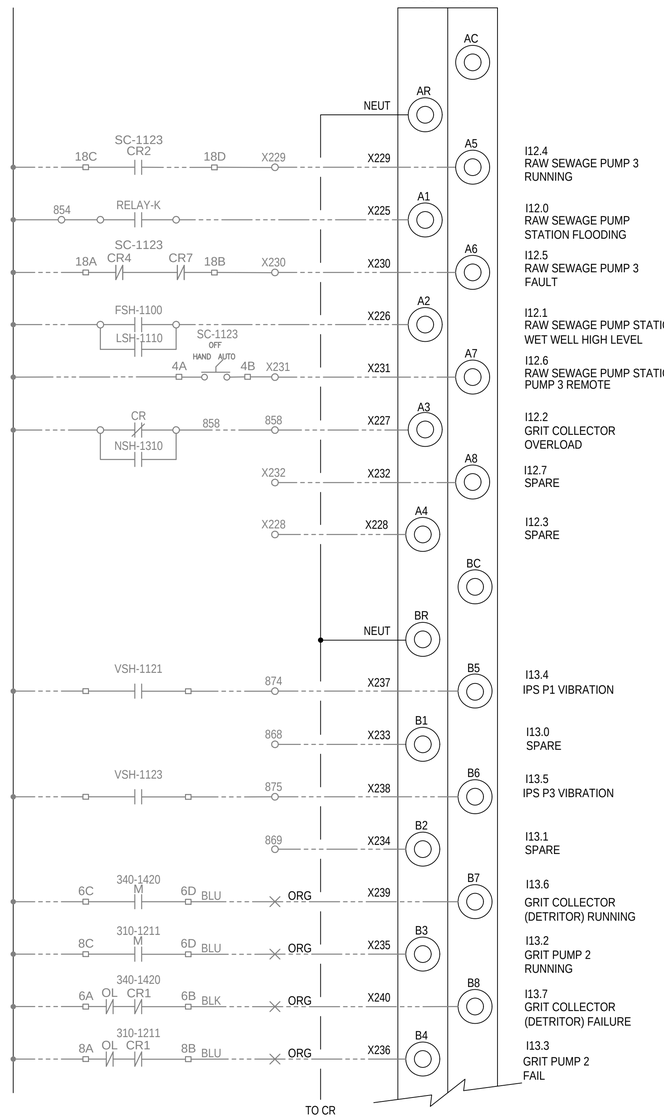
Title
INFLUENT PUMPS
EXISTING IO -II

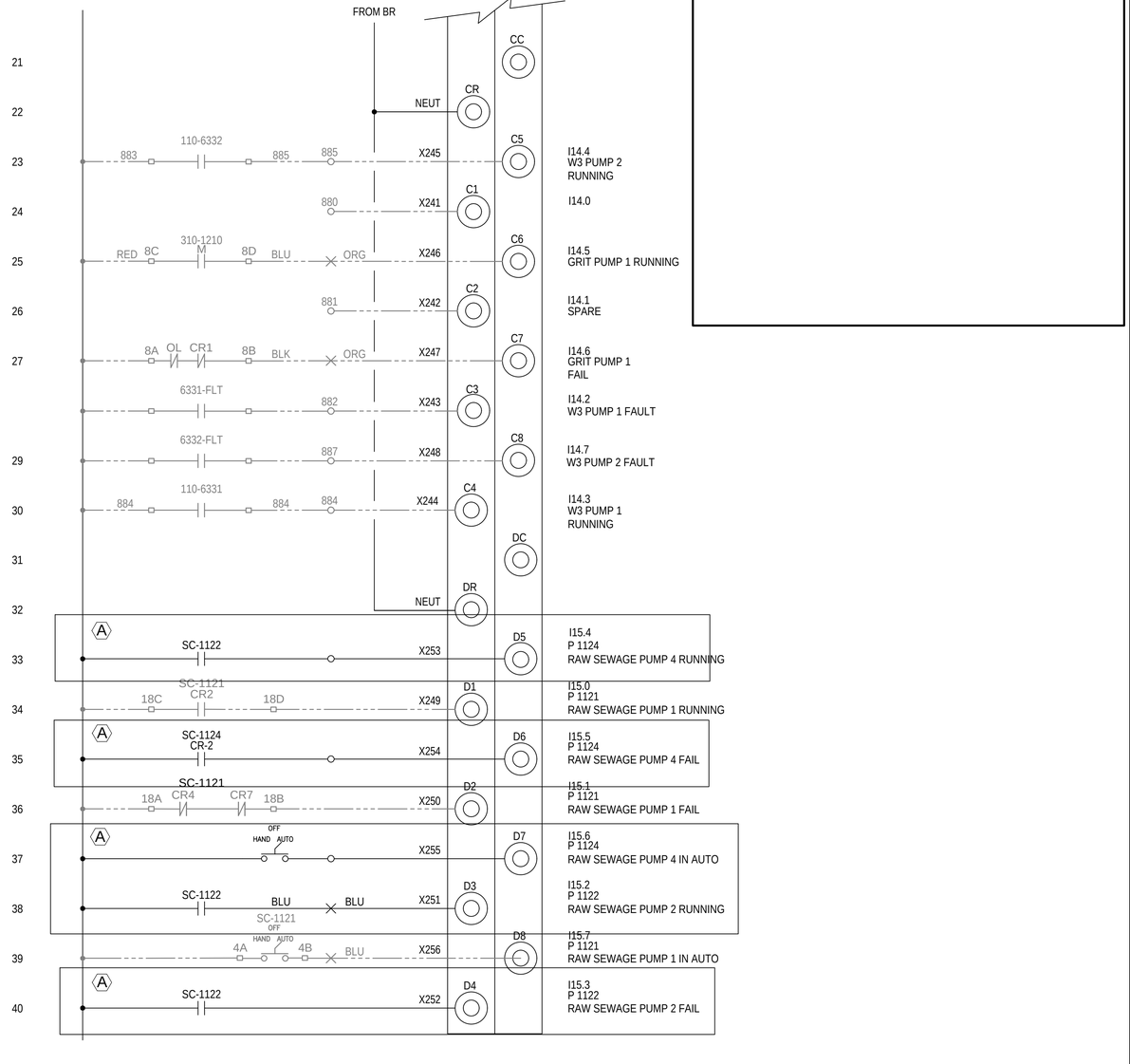
Revision:

Drawing No.
I-603

ORIGINAL SHEET - ANSI D

PLC 1, NODE 1, SLOT 5
110VAC INPUT MODULE
505-4232A





SHEET KEYNOTES

A. USE EXISTING WIRES SHOWN HERE FOR PUMP 2 AND PUMP 4 STATUS SIGNALS. RE-TERMINATE EXISTING WIRES ON NEW VFD'S. INDIVIDUAL TERMINALS IN PLC1 PANEL ARE NOT LABELED BUT CAN BE IDENTIFIED BY WIRE NUMBERS AND TERMINAL STRIP LABEL. PUMP 2 TERMINAL STRIP IS LOCATED IN THE LOWER LEFT OF PLC1 PANEL AND IDENTIFIED AS "PUMP2-DI/O". PUMP 4 TERMINAL STRIP IS LOCATED IN LOWER LEFT OF PLC1 PANEL AND IDENTIFIED AS "PUMP4-DI".

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CLACKAMAS WATER ENVIRONMENT SERVICES

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REGISTERED PROFESSIONAL ENGINEER
89440PE
OREGON
DEC 17, 2014
CARL M SERPA

EXPIRES: 06/30/2022

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES

KELLOGG CREEK WATER RESOURCE RECOVER FACILITY INFLUENT PUMPS

CLACKAMAS COUNTY, OREGON

Project No.: 20020061 72

File Name: I602 IO SHEET 3

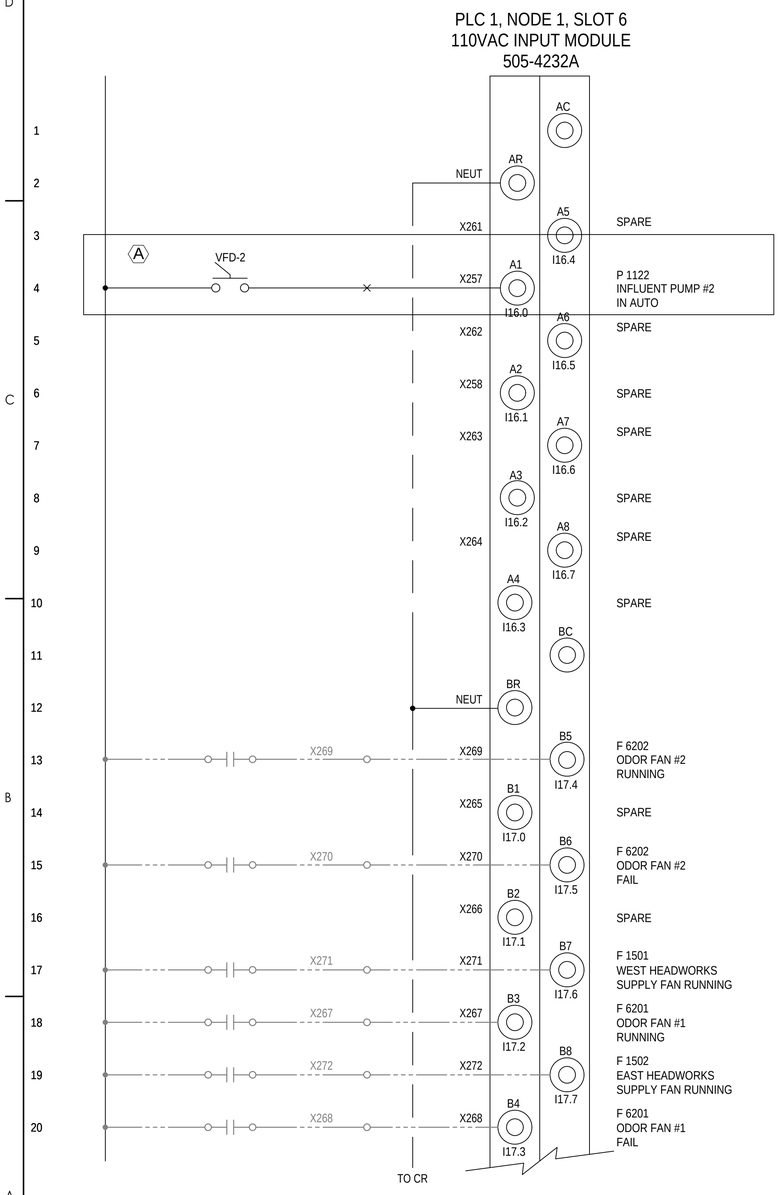
Scale: NO SCALE

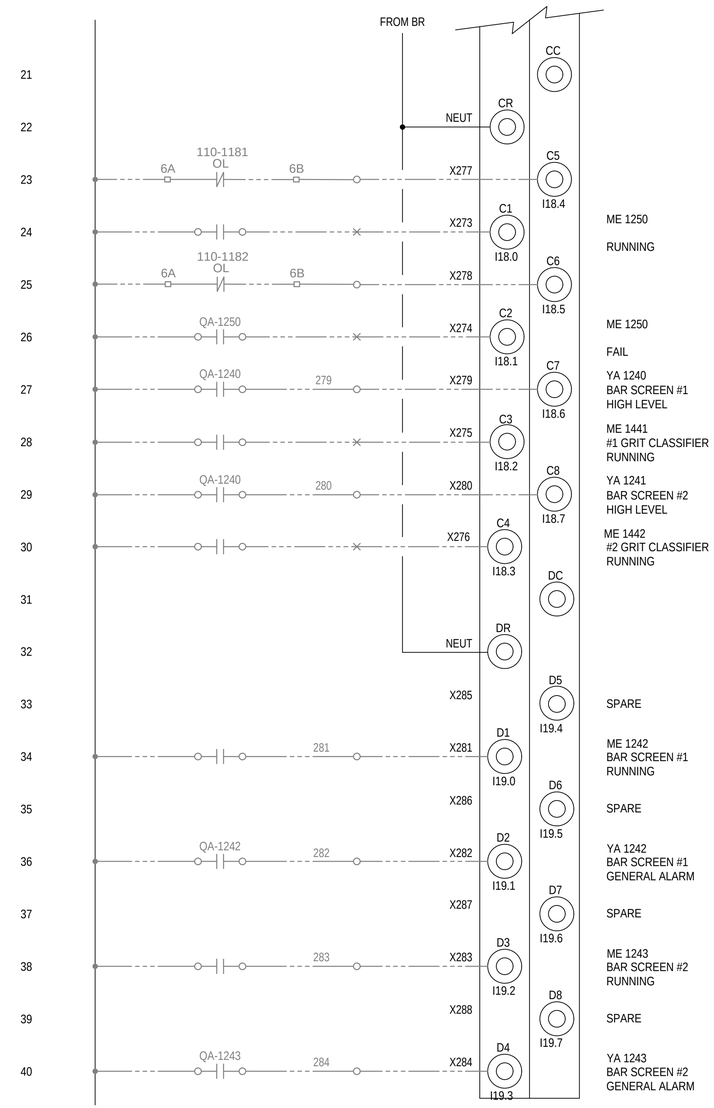
CMS	CMS	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
INFLUENT PUMPS
EXISTING IO - III

Revision:

Drawing No.
I-604





SHEET KEYNOTES

A. USE EXISTING WIRES SHOWN HERE FOR PUMP 2 AND PUMP 4 STATUS SIGNALS. RE-TERMINATE EXISTING WIRES ON NEW VFD'S. INDIVIDUAL TERMINALS IN PLC1 PANEL ARE NOT LABELED BUT CAN BE IDENTIFIED BY WIRE NUMBERS AND TERMINAL STRIP LABEL. PUMP 2 TERMINAL STRIP IS LOCATED IN THE LOWER LEFT OF PLC1 PANEL AND IDENTIFIED AS "PUMP2-DI/O". PUMP 4 TERMINAL STRIP IS LOCATED IN LOWER LEFT OF PLC1 PANEL AND IDENTIFIED AS "PUMP4-DI".

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0	FOR CONSTRUCTION	LS	HS	2021.11.23

No.	Issued	By	Appd	YYYY.MM.DD
B	90% PROGRESS PRINTS	LS	HS	2021.08.11
A	30% PROGRESS PRINTS	LS	HS	2021.05.24

REGISTERED PROFESSIONAL ENGINEER
89440PE
OREGON
DEC 17, 2014
CARL M SERPA
EXPIRES: 06/30/2022

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVER FACILITY INFLUENT PUMPS
CLACKAMAS COUNTY, OREGON

Project No.: 2002006172
File Name: I602 IO SHEET 4
Scale: NO SCALE

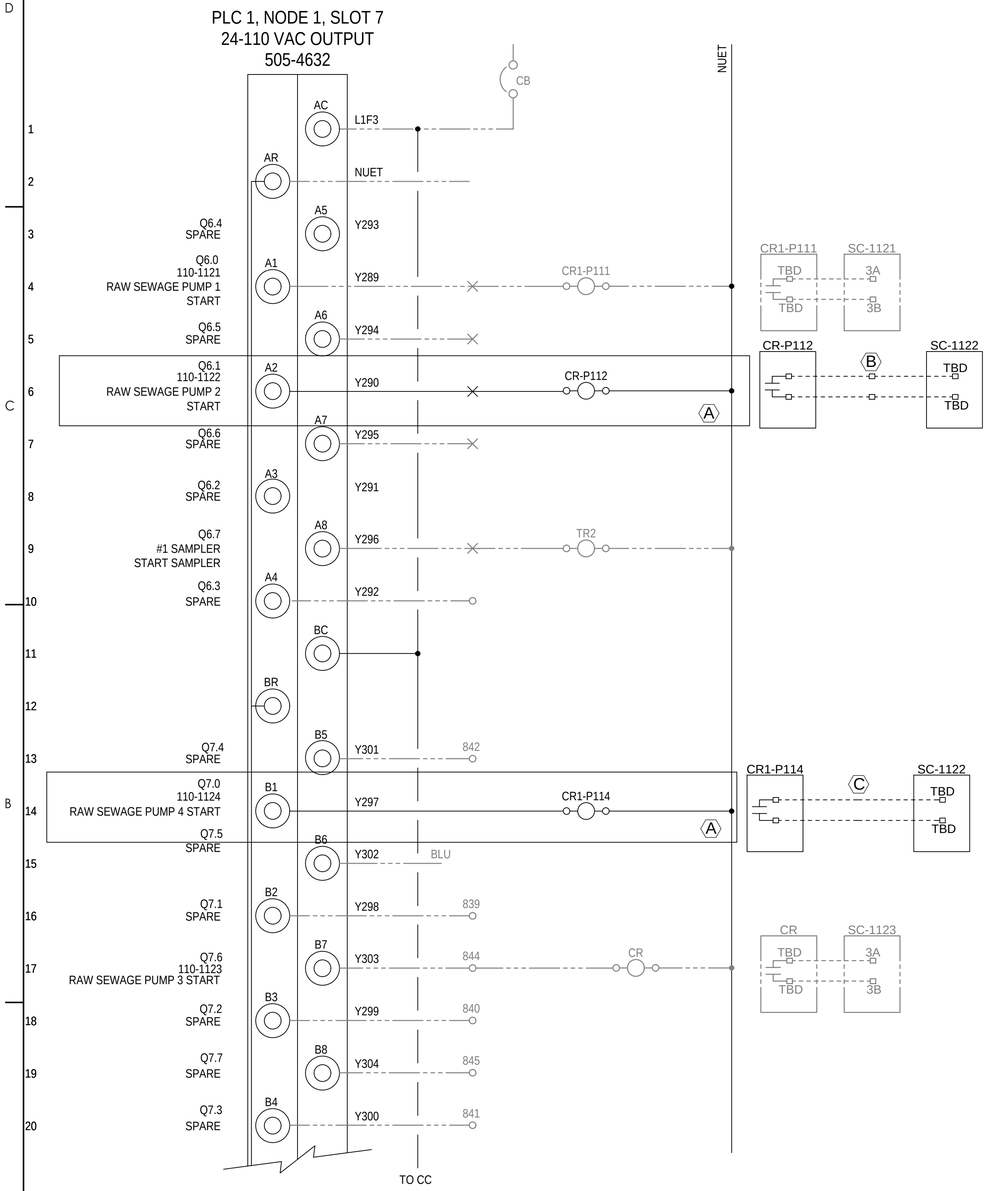
CMS	CMS	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

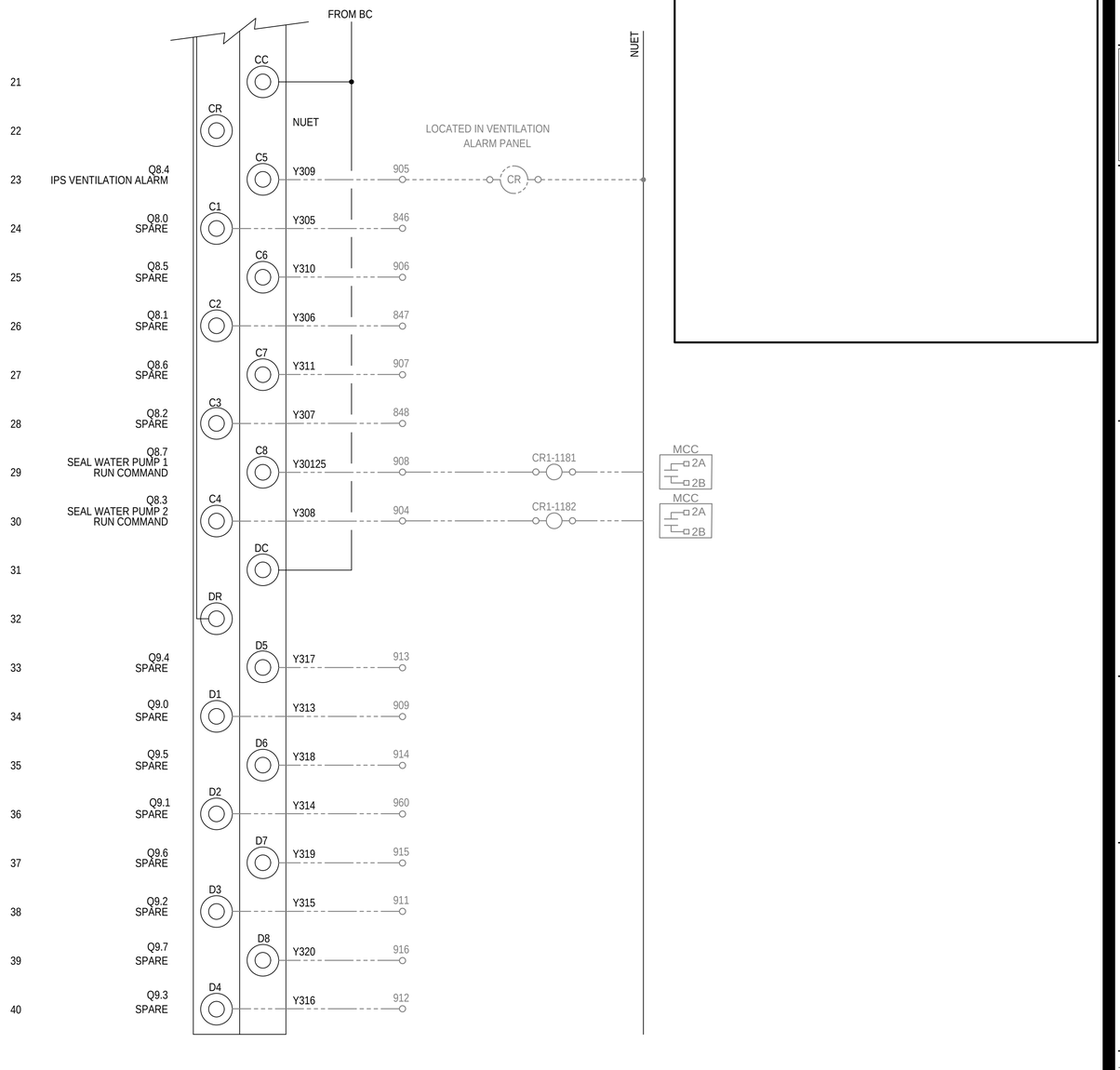
Title
INFLUENT PUMPS
EXISTING IO - IV

Revision:
Drawing No.
I-605

C:\Users\carl.serpa\Documents\pw_2021\project files\v16\l-exis-stantec kellogg ips pump design\design\drawings\dwg\I&C\I602 io sheet 4
2021.10.22 10:17:49 AM

ORIGINAL SHEET - ANSI D





SHEET KEYNOTES

A. USE EXISTING WIRES SHOWN HERE FOR PUMP 2 AND PUMP 4 STATUS SIGNALS. RE-TERMINATE EXISTING WIRES ON NEW VFD'S.

B. THESE TERMINAL BLOCKS LOCATED IN PLC1 PANEL ARE NOT INDIVIDUALLY LABELED. THE TERMINAL STRIP IS LOCATED IN LOWER LEFT OF PLC1 PANEL AND IS LABELED "PUMP 2-DI/O".

C. FIELD WIRES ON THIS RELAY ARE TERMINATED DIRECTLY ON RELAY BASE (NO EXTERNAL TERMINALS).

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CLACKAMAS WATER ENVIRONMENT SERVICES

Revision	By	Appd	YYYY.MM.DD
0 FOR CONSTRUCTION	LS	HS	2021.11.23
A 30% PROGRESS PRINTS	LS	HS	2021.05.24
B 90% PROGRESS PRINTS	LS	HS	2021.08.11

Issued

REGISTERED PROFESSIONAL ENGINEER
89440PE
OREGON
DEC 17, 2014
CARL M SERPA

EXPIRES: 06/30/2022

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES

KELLOGG CREEK WATER RESOURCE RECOVER FACILITY INFLUENT PUMPS

CLACKAMAS COUNTY, OREGON

Project No.: 2002006172

File Name: I602 IO SHEET 5

Scale: NO SCALE

CMS	CMS	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
INFLUENT PUMPS
EXISTING IO - V

Revision:

Drawing No.
I-606

ORIGINAL SHEET - ANSI D

GENERAL NOTES

GENERAL

1. PROCESS MECHANICAL EQUIPMENT AND PIPING LOCATIONS, DIMENSIONS, AND LAYOUTS ARE BASED ON THE EQUIPMENT SELECTED AND SPECIFIED BY THE ENGINEER. IF THE CONTRACTOR PROPOSES TO FURNISH EQUIPMENT THAT REQUIRES AN ARRANGEMENT OR SPACE OTHER THAN THAT INDICATED ON THE DRAWINGS OR AS SPECIFIED, THE CONTRACTOR SHALL PREPARE AND SUBMIT TO THE ENGINEER FOR APPROVAL DETAILED DRAWINGS AND EQUIPMENT LISTS (FOR IMPACTED DISCIPLINES) SHOWING EQUIPMENT AND PIPING LOCATIONS, DIMENSIONS, AND LAYOUTS PROPOSED. THIS INFORMATION SHALL INCLUDE, BUT NOT BE LIMITED TO, PLANS, SECTIONS, DETAILS, AND SCHEMATICS OF EQUIPMENT AND APPURTENANCES REQUIRED. THE CONTRACTOR SHALL PROVIDE DETAILS OF CHANGES TO ADJACENT PIPE ROUTING TO ACCOMMODATE TIE-IN LOCATIONS FOR PROPOSED EQUIPMENT.
2. OTHER DISCIPLINE BACKGROUND DRAWINGS AND DIMENSIONS SHOWN ON THE PROCESS MECHANICAL DRAWINGS ARE FOR REFERENCE ONLY. THE CONTRACTOR SHALL CLARIFY DISCREPANCIES BETWEEN DISCIPLINES WITH THE ENGINEER PRIOR TO THE FABRICATION OR CONSTRUCTION..
3. EQUIPMENT FOUNDATION AND PAD DIMENSIONS SHOWN ON THE PROCESS MECHANICAL DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL COORDINATE EQUIPMENT PAD DIMENSIONS WITH THE MANUFACTURER TO ACCOMMODATE THE ACTUAL SIZE OF EQUIPMENT FURNISHED (AS SHOWN ON THE APPROVED SHOP DRAWINGS) AND AVAILABLE SPACE. REFER TO THE STRUCTURAL DRAWINGS AND STRUCTURAL STANDARD DETAILS FOR EQUIPMENT PAD DESIGN REQUIREMENTS.
4. EQUIPMENT BASES HAVING DRAIN OUTLETS, EQUIPMENT DRAINS, AND PIPING DRAINS SHALL BE PIPED WITH A CONTINUOUS SLOPE TO THE NEAREST FLOOR DRAIN, FLOOR SINK, HUB DRAIN, OR TRENCH DRAIN. DRAIN PIPE NOMINAL DIAMETER AND MATERIAL SHALL BE PER THE EQUIPMENT MANUFACTURER'S RECOMMENDATIONS. DRAIN PIPING SHALL BE SUITABLY SUPPORTED AND ROUTED IN SUCH A MANNER TO AVOID TRIP HAZARDS.
5. WHERE WELDING OF STAINLESS STEEL IS REQUIRED, PASSIVATE STAINLESS STEEL AFTER WELDING.

PIPING

1. CONTRACTOR SHALL PROVIDE INTERCONNECTING PIPING, FITTINGS, WALL PIPES, AND PIPE SUPPORTS (INCLUDING THOSE REQUIRED FOR INSTRUMENTS, DRAINS, AND OTHER APPURTENANCES) AS REQUIRED FOR A COMPLETE PROCESS MECHANICAL PIPING SYSTEM.
2. FOR CLARITY, SMALL DIAMETER PROCESS PIPING MAY NOT BE SHOWN IN ITS ENTIRETY. THE CONTRACTOR SHALL REFER TO THE CONTRACT DOCUMENTS TO DETERMINE THE NEW WORK ASSOCIATED WITH EACH PIPING SYSTEM TO COMPLETE THE WORK.
3. PROCESS MECHANICAL PIPING SYSTEMS AND EQUIPMENT SHALL BE INSTALLED IN SUCH A WAY TO BE EASILY DISMANTLED AND REMOVED WITHOUT DISTURBING THE REMAINING AND ADJACENT EQUIPMENT, PIPING, AND SUPPORTS.
4. PIPING CONNECTED TO PROCESS MECHANICAL EQUIPMENT SHALL BE INSTALLED AND SUPPORTED SUCH THAT IT DOES NOT IMPART STRAIN ON THE EQUIPMENT.
5. UNLESS OTHERWISE SHOWN, HORIZONTAL REDUCERS INSTALLED IN PIPING SYSTEMS SHALL BE ECCENTRIC (BOTTOM FLAT). HORIZONTAL REDUCERS CONNECTED TO PUMP SUCTIONS SHALL BE ECCENTRIC (TOP FLAT).
6. UNLESS OTHERWISE SHOWN, ELBOWS 2-1/2" AND LARGER SHALL BE STANDARD LONG RADIUS ELBOWS. WHERE REQUIRED IN TIGHT AREAS FOR FIT-UP, USE SHORT RADIUS OR REDUCING ELBOWS.
7. A MINIMUM HEADROOM CLEARANCE HEIGHT OF 7'-0" SHALL BE PROVIDED FOR OVERHEAD PROCESS MECHANICAL PIPING SYSTEMS.
8. SLEEVE COUPLINGS, FLANGED COUPLING ADAPTERS, AND FLEXIBLE COUPLINGS SUBJECT TO A POSITIVE INTERNAL FLUID PRESSURE SHALL BE PROVIDED WITH RESTRAINT SYSTEMS.

PIPE SUPPORTS

1. FOR MATERIALS, SPACING, AND ADDITIONAL REQUIREMENTS RELATED TO PIPE SUPPORTS, SEE THE SPECIFICATION SECTION "PIPE SUPPORTS".
2. PROVIDE PIPE SUPPORTS REQUIRED FOR A COMPLETE PIPING SYSTEM. PIPE SUPPORTS SHALL BE PROVIDED WHERE REQUIRED BY THE SPECIFICATION SECTION 'PIPE SUPPORTS' AND/OR AT POINTS MARKED WITH AN "X" ON PLAN VIEW DRAWINGS.
3. WHEN FIBERGLASS OR PVC-COATED PIPE SUPPORT MATERIALS ARE CUT OR DRILLED, THE CUT EXPOSED END OF THE MATERIAL SHALL BE RE-COATED OR SEALED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
4. PIPE SUPPORTS FOR PLASTIC PIPE OR FIBERGLASS PIPE SHALL BE PROVIDED WITH EXTRA WIDE PIPE SADDLES OR METALLIC SHIELDS WITH LOOSE FIT AROUND THE FULL CIRCUMFERENCE OF THE PIPE AT EACH PIPE SUPPORT.
5. PIPE SUPPORTS FOR COPPER PIPE OR TUBING SHALL BE PROVIDED WITH A 2" WIDE BY 1/8" THICK STRIP OF RUBBER FABRIC (OR SIMILAR SUITABLE MATERIAL) AROUND FULL CIRCUMFERENCE OF THE PIPE AT EACH PIPE SUPPORT.
6. SUPPORT STRUT CHANNEL ENDS THAT EXTEND INTO PERSONNEL TRAFFIC AREAS SHALL HAVE PLASTIC END CAPS.

VALVES AND GATES

1. VALVE AND GATE ACTUATORS SHALL BE MOUNTED TO ALLOW PROPER OPENING AND CLOSING WITHOUT INTERFERENCE WITH ADJACENT PIPING OR EQUIPMENT. UNLESS INDICATED ON THE DRAWINGS, ORIENTATION OF OPERATORS SHALL BE APPROVED BY THE ENGINEER
2. UNLESS INDICATED ON THE DRAWINGS, REFER TO THE MANUFACTURER'S RECOMMENDATIONS AND PROJECT SPECIFICATIONS REGARDING THE LOCATION OF THE VALVE SEAT (UPSTREAM OR DOWNSTREAM) AND STEM ORIENTATION.

GENERAL PROCESS MECHANICAL SYMBOLS

VALVE AND GATE ACTUATORS

- DIAPHRAGM OPERATOR
- D = DIGITAL
E/H = ELECTROHYDRAULIC
P = PNEUMATIC
S = SOLENOID
T = TEMPERATURE
- HAND / MANUAL OPERATOR
(ALSO SHOWN AS NO OPERATOR)
- MOTOR OPERATOR

VALVES

- AIR VACUUM, AIR RELEASE, OR
AIR VACUUM AND AIR RELEASE ASSEMBLY
- BALL VALVE
- BUTTERFLY VALVE
- CHECK VALVE - SILENT
- CHECK VALVE - STOP
- GATE VALVE
- HOSE BIBB VALVE
FROM TOP, FRONT AND SIDE VIEW
- PLUG VALVE - ECCENTRIC
- PLUG VALVE - LUBRICATED

GATES

- SLIDE GATE
(CAST IRON, ALUMINUM OR STAINLESS STEEL)
- STOP GATE OR SHEAR GATE

FLOW MEASUREMENT INSTRUMENTS

- MAGNETIC FLOWMETER

PUMPS & COMPRESSORS

- CENTRIFUGAL PUMP

PIPING ENDS (SINGLE-LINE)

- BLIND FLANGE
- CAP - BREATHER
- CAP - SCREW / THREADED
- CAP - WELDED
- CAP - QUICK DISCONNECT
- EXPANSION JOINT
- FLANGED
- FLANGED COUPLING ADAPTER
- FLANGED COUPLING ADAPTER - RESTRAINED
- OR FLEXIBLE CONNECTION - BELLOWS TYPE
- GROOVED END COUPLING
- MECHANICAL JOINT
- PIPE MATERIAL CHANGE
- REDUCER - CONCENTRIC
- REDUCER - ECCENTRIC
- REMOVABLE SPOOL PIECE
- SLEEVE TYPE COUPLING
- SLEEVE TYPE COUPLING - RESTRAINED
- UNION
- WELDED

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CLACKAMAS WATER ENVIRONMENT SERVICES

Issued	By	Appd	YYYY.MM.DD
A	AO	HS	2021.05.24
B	AO	HS	2021.08.11
0	LS	HS	2021.11.23
Revision			

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 58599 OREGON JULY 21, 1998 HEATHER M. STEPHENS
EXPIRATION DATE: 12/31/22

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

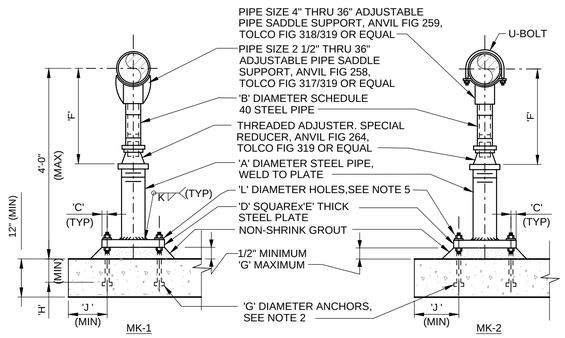
Project No.: 2002006172
File Name: 06172D-001
Scale: NO SCALE

Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
REM	AO		2021.11.23

Title
GENERAL NOTES AND SYMBOLS

Revision:
Drawing No.
D-001

ORIGINAL SHEET - ANSI D



DIMENSIONS IN INCHES													Sds<0.8	
NOMINAL PIPE DIAMETER	'A' (SCH 40 UNO)	'B'	'C'	'D'	'E'	'F' (APPROX) (MINIMUM)	'F' (APPROX) (MAXIMUM)	'G'	'H'	'J'	'K'	'L'	LOAD MAX (LBS)	'M'
2 1/2	* 2 / 2 1/2	1 1/2	1	8	7/16	7	11 1/2	1/2	4	6	3/8	13/16	850	300
3	* 2 / 2 1/2	1 1/2	1	8	7/16	7 5/16	11 13/16	1/2	4	6	3/8	13/16	850	300
3 1/2	* 2 / 2 1/2	1 1/2	1	8	7/16	7 9/16	12 1/16	1/2	4	6	3/8	13/16	850	300
4	3	* 2 1/2 / 3	1 1/4	10	5/8	10 1/4	14 3/4	5/8	5	8	7/16	1 1/16	1675	200
6	3	* 2 1/2 / 3	1 1/4	10	5/8	11 9/16	16 1/16	5/8	5	8	7/16	1 1/16	1675	200
8	3	* 2 1/2 / 3	1 1/4	10	5/8	13 9/16	18 1/16	5/8	5	8	7/16	1 1/16	1675	200
10	3	* 2 1/2 / 3	1 1/4	10	5/8	14 5/8	19 1/8	5/8	5	8	7/16	1 1/16	1675	200
12	3	* 2 1/2 / 3	1 1/4	10	5/8	15 5/8	20 1/8	5/8	5	8	7/16	1 1/16	1675	200
14	4	3	1 3/8	12	3/4	18 7/8	23 3/8	3/4	7	10.5	1/2	1 5/16	2650	1400
16	4	3	1 3/8	12	3/4	19 7/8	24 3/8	3/4	7	10.5	1/2	1 5/16	2650	1400
18	6 (SCH 80)	* 4 / 3 1/2	1 5/8	14	1 1/4	22 1/4	26 3/4	7/8	8	12	11/16	1 9/16	3800	1750
20	6 (SCH 80)	* 4 / 3 1/2	1 5/8	14	1 1/4	23 1/4	27 3/4	7/8	8	12	11/16	1 9/16	3800	1750
24	6 (SCH 80)	4	1 5/8	14	1 1/4	26 1/2	31	7/8	8	12	11/16	1 9/16	3800	1750
30	6 (SCH 80)	4	1 7/8	16	1 1/4	29 5/8	34 1/8	1	8	12	11/16	1 13/16	5100	1925
32	6 (SCH 80)	4	1 7/8	16	1 1/4	30 5/8	35 1/8	1	8	12	11/16	1 13/16	5100	1925
36	6 (SCH 80)	4	1 7/8	16	1 1/4	32 5/8	37 1/8	1	8	12	11/16	1 13/16	5100	1925

* SEE MANUFACTURER

NOTES:

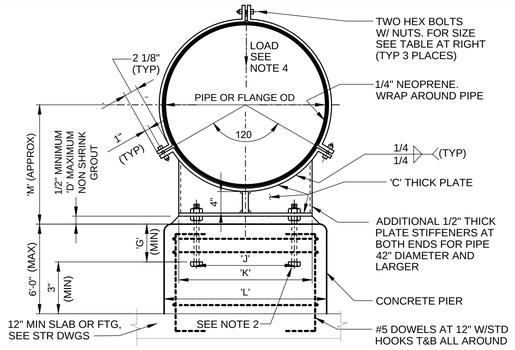
1. HOT DIP GALVANIZE PARTS AFTER FABRICATION, UNO. PROVIDE 316 SS PARTS AND BOLTS IN SUBMERGED OR CORROSIVE CONDITIONS.
2. PROVIDE CAST-IN-PLACE HEAVY HEX HEAD ASTM F1554 GR 36 ANCHORS, UNO.
3. REFER TO TABLE FOR MAXIMUM ALLOWABLE SERVICE LOAD ON EACH SUPPORT
4. USE MK-2, UNLESS OTHERWISE INDICATED.
5. FOR 3/4" ANCHORS AND LARGER, PROVIDE SQUARE WASHERS PER AISC MANUAL OF STEEL CONSTRUCTION TABLE 14-2 WITH STD HOLES WELDED TO PLATE WITH 3/16" FILLETS. USE 1 3/4" SQ x3/16" THICK WASHERS FOR 5/8" ANCHORS.
6. IF ADHESIVE ANCHORS ARE USED (SIMPSON SET XP, OR EQUAL), USE REDUCED MAX LOADS IN COLUMN 'M'. OVERSIZED HOLES AND WASHERS ARE NOT REQUIRED.

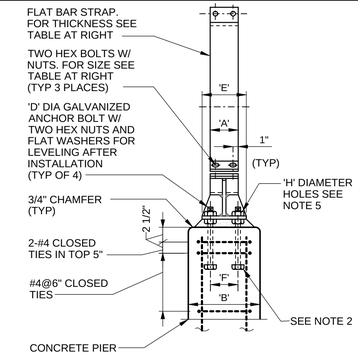
SEISMIC AND WIND COMPLIANT DESIGN CRITERIA

1. THE SUPPORTS ARE ADEQUATE FOR SEISMIC RESPONSE COEFFICIENT (SDS) GIVEN IN THE TABLE. SEISMIC FORCE ASSUMPTIONS (ASCE 7-10, EQN 13.3-1): ap=2.5, Rp=6, 2. , Ip 1.0, /h 1.0.
2. THE SUPPORTS, DESIGNED FOR SEISMIC LOADS, ARE ALSO ADEQUATE FOR A DESIGN WIND SPEED (Vult) OF UP TO 165 MPH WITH A MAXIMUM HEIGHT ABOVE GRADE OF 40'. WIND FORCE ASSUMPTIONS: EXPOSURE CATEGORY C, Kzt=1.0, Kz=1.04, Kd=0.95, G=0.85, Cf=1.2 (DESIGNED PER ASCE 7-10 SECTION 29.5 - OTHER STRUCTURES).

D-108 ADJ PIPE SUPPORT W OR W/O 'U' BOLT

(FOR PIPE 36" DIAMETER AND SMALLER)





DIMENSIONS IN INCHES																				Sds≤0.5
NOMINAL PIPE DIAMETER										STRAP	SUPPORTING									LOAD MAX (LBS)
											PIPE				FLANGE					
	A	B	C	D	E	F	G	H		BOLT SIZE / FLAT BAR	J	K	L	M	J	K	L	M	
6	4	12	3/8	5/8	6	3 3/8	10	1 1/16		1/2 / 1/4	4	7	12	10	6	11	16	13		450
8	4	12	3/8	5/8	6	3 3/8	10	1 1/16		1/2 / 1/4	5	8	13	11	7 1/2	13	18	14		800
10	4	12	3/8	5/8	6	3 3/8	10	1 1/16		1/2 / 1/4	6	9	15	12	9	15	20	15		1200
12	4	12	3/8	5/8	6	3 3/8	10	1 1/16		1/2 / 1/4	8	11	17	13	11	17	22	16		1600
14	4	12	3/8	5/8	6	3 3/8	10	1 1/16		1/2 / 1/4	9	12	18	14	12	18	24	17		2300
16	4	12	3/8	5/8	6	3 3/8	10	1 1/16		1/2 / 1/4	10	13	19	15	13	20	25	18		3000
18	4	12	3/8	5/8	6	3 3/8	10	1 1/16		1/2 / 1/4	11	14	22	16	14	21	28	19		3700
20	5	12	3/8	5/8	6	3 3/8	10	1 1/16		5/8 / 3/8	11	15	23	17	15	23	30	21		5050
22	5	12	3/8	5/8	6	3 3/8	10	1 1/16		5/8 / 3/8	11	18	24	18	15	25	31	22		6400
24	5	14	3/8	5/8	6	3 3/8	10	1 1/16		5/8 / 3/8	11	19	24	19	15	26	32	23		7750

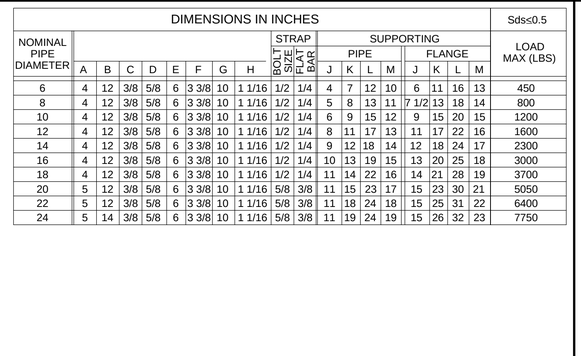
NOTES:

1. HOT DIP GALVANIZE PARTS AFTER FABRICATION, UNO. PROVIDE 316SS PARTS AND BOLTS IN SUBMERGED OR CORROSIVE CONDITIONS.
2. PROVIDE CAST-IN PLACE HEAVY HEX HEAD ASTM F1554 GR 36 ANCHORS, UNO.
3. WHEN SUPPORTING PIPE AND FLANGE ALTERNATIVELY ON THE SAME LINE, CONCRETE PIERS FOR PIPE SUPPORTS SHALL ALL HAVE THE SAME DIMENSION 'L' FOR FLANGE SUPPORT.
4. REFER TO TABLE FOR MAXIMUM ALLOWABLE UNFACTORED LOAD ON EACH SUPPORT.
5. FOR 3/4" ANCHORS AND LARGER, PROVIDE SQUARE WASHERS PER AISC MANUAL OF STEEL CONSTRUCTION TABLE 14-2 WITH STD HOLES WELDED TO PLATE WITH 3/16" FILLETS. USE 1 3/4" SQ x3/16" THICK WASHERS FOR 5/8" ANCHORS.
6. IF ADHESIVE ANCHORS ARE USED (SIMPSON SET XP, OR EQUAL), MULTIPLY MAX LOADS BY 75%. OVERSIZED HOLES AND WASHERS ARE NOT REQUIRED.

SEISMIC AND WIND COMPLIANT DESIGN CRITERIA

1. THE SUPPORTS ARE ADEQUATE FOR SEISMIC RESPONSE COEFFICIENT (SDS) GIVEN IN THE TABLE. SEISMIC FORCE ASSUMPTIONS (ASCE 7-10, EQN 13.3-1): ap=2.5, Rp=6, 2. , Ip 1.0, /h 1.0 FOR " TO 1 " PIPES, /h 0. FOR PIPES LARGER THAN 1 ".

D-110 PIPE SUPPORT WITH STRAP



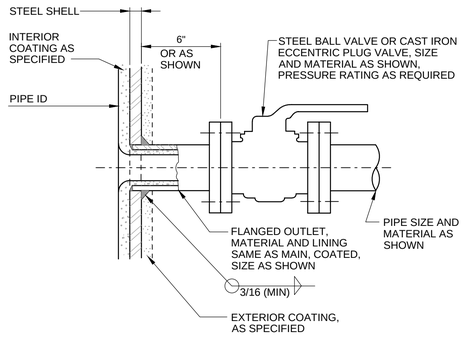
NOTE:

1. PROVIDE DIELCTRIC COUPLING FOR DISSIMILAR METAL CONNECTIONS.

D-120 PIPE CONNECTION

(FOR PIPE AND VALVE 2 1/2" DIAMETER AND SMALLER)

REV 010119



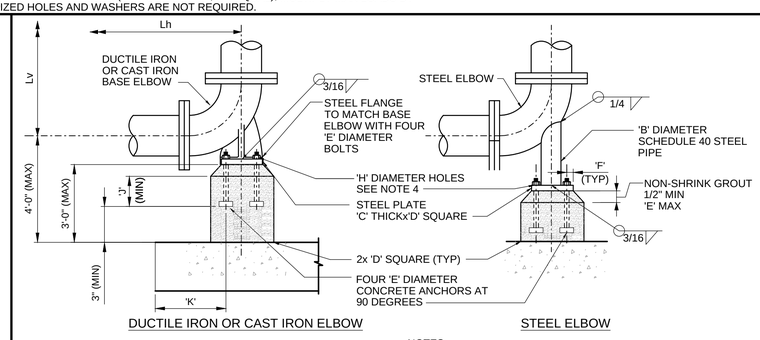
NOTE:

1. PROVIDE DIELECTRIC COUPLING FOR DISSIMILAR METAL CONNECTIONS.

D-133 PIPELINE CONNECTION

(FOR PIPE AND VALVE 3" DIAMETER AND LARGER)

REV 010119



DIMENSIONS IN INCHES (UNO)										S_{DS}<0.5 (NOTE 8)
NOMINAL PIPE DIAMETER	'B'	`C'	`D'	'E'	'F'	'H'	'J'	'K'	'L'	'L' ADH
4	2	3/8	6	5/8	1 3/8	1 1/16	4 1/2	12	33'	17'
6	2 1/2	3/8	7	5/8	1 3/8	1 1/16	8	12	38'	19'
8	4	1/2	10	5/8	1 3/8	1 1/16	8	12	43'	22'
10	4	1/2	10	5/8	1 3/8	1 1/16	8	12	43'	22'
12	6	5/8	11	7/8	1 7/8	1 9/16	9	12	48'	18'
14	6	5/8	11	7/8	1 7/8	1 9/16	9	12	48'	18'
16	6	5/8	17	1	2 1/4	1 13/16	9	13	52'	20'
18	8	5/8	17	1	2 1/4	1 13/16	9	13	52'	20'
20	8	3/4	21	1	2 1/4	1 13/16	9	13	57'	22'
24	8	3/4	21	1	2 1/4	1 13/16	9	13	57'	22'
30	10	7/8	24	1 1/4	2 5/8	2 1/16	9	16	57'	22'
36	12	7/8	32	1 1/4	2 5/8	2 1/16	9	16	57'	22'
42	16	1	32	1 1/2	3	2 5/16	11	16	57'	NA
48	18	1 1/8	38	1 3/4	3 1/2	2 3/4	12	22	57'	NA

NOTES:

1. PROVIDE CAST-IN-PLACE HEAVY HEX HEAD ASTM F1554 GR 36 ANCHORS, UNO.
2. HOT DIP GALVANIZE PARTS AFTER FABRICATION, UNO. PROVIDE 316SS PARTS AND BOLTS IN SUBMERGED OR CORROSIVE CONDITIONS.
3. 'L' IS ALLOWABLE LONGITUDINAL TRIBUTARY LENGTH, DEFINED AS 1/2 THE VERTICAL DISTANCE TO THE NEXT LATERAL PIPE SUPPORT (Lv) PLUS 1/2 THE HORIZONTAL DISTANCE TO THE NEXT LONGITUDINAL PIPE SUPPORT (Lh). REFER TO TABLE FOR MAXIMUM ALLOWABLE 'L' FOR EACH SUPPORT.
4. FOR 3/4" ANCHORS AND LARGER, PROVIDE SQUARE WASHERS PER AISC MANUAL OF STEEL CONSTRUCTION TABLE 14-2 WITH STD HOLES WELDED TO PLATE WITH 3/16" FILLETS. USE 1 3/4" SQx3/16" THICK WASHERS FOR 5/8" ANCHORS.
5. IF ADHESIVE ANCHORS ARE USED (SIMPSON SET XP, OR EQUAL), USE REDUCED ALLOWABLE LONGITUDINAL TRIBUTARY LENGTH, 'L' ADH, GIVEN IN TABLE. OVERSIZED HOLES AND WASHERS ARE NOT REQUIRED. DO NOT USE ADHESIVE ANCHORS FOR PIPES LARGER THAN 36" DIAMETER.
6. CONCRETE BASE 3000 PSI STRENGTH.
7. #4 BARS AT 12" O.C. EACH FACE.
8. CONTRACTOR TO REVISE DIMENSIONS BASED ON PROJECT-SPECIFIC SDS VALUE OF 0.71.

SEISMIC AND WIND COMPLIANT - DESIGN CRITERIA

1. THE SUPPORTS ARE ADEQUATE FOR SEISMIC RESPONSE COEFFICIENT (SDS) GIVEN IN THE TABLE. SEISMIC FORCE ASSUMPTIONS (ASCE 7-10, EQN 13.3-1): ap=2.5, Rp=6, 2. , Ip 1.0, /h 1.0 FOR " TO 1 " PIPES, /h 0. FOR PIPES LARGER THAN 1 ".

D-140 ELBOW SUPPORT

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CLACKAMAS WATER ENVIRONMENT SERVICES

Issued	By	Appd	YYYY.MM.DD
A. 30% PROGRESS PRINTS	LS	HS	2021.11.23
B. 90% PROGRESS PRINTS	LS	HS	2021.08.11
0 FOR CONSTRUCTION	LS	HS	2021.05.24
Revision	By	Appd	YYYY.MM.DD

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 58599 OREGON JULY 21, 1989 HEATHER M. STEPHENS

EXPIRATION DATE: 6/30/22

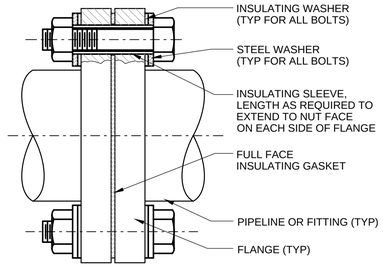
Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172
File Name: 06172D-002
Scale: NO SCALE

MT	LS	GT	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
STANDARD DETAILS - I

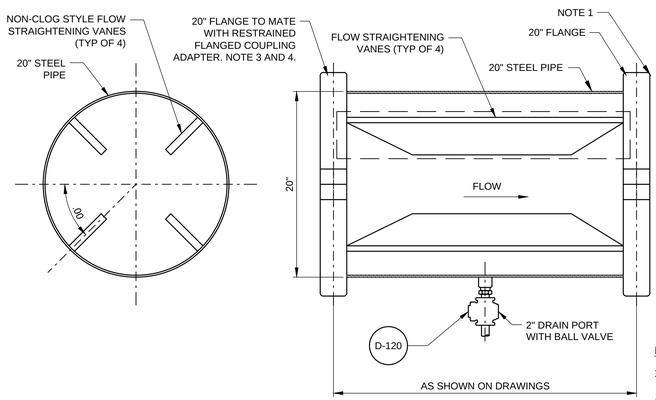
Revision:
Drawing No.
D-002



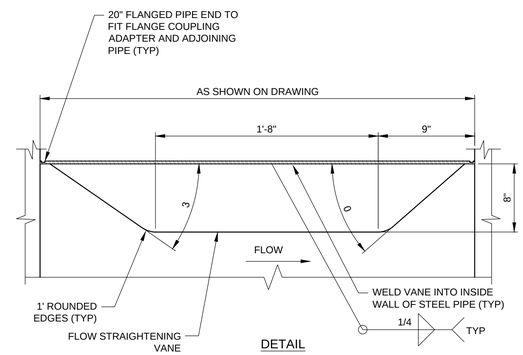
NOTES:

1. ABOVE GRADE INSULATING FLANGE INSTALLATION SHOWN.
2. FOR BURIED INSULATING FLANGE INSTALLATION, DO NOT INSTALL INSULATING WASHER ON PROTECTED SIDE OF INSULATING FLANGE.

D-160 INSULATING FLANGE

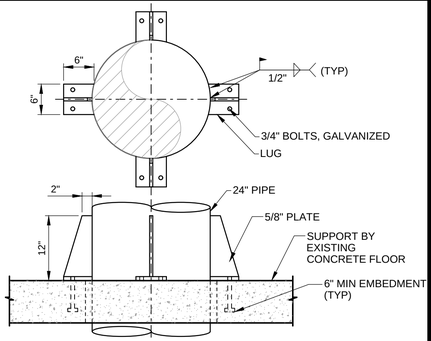


D-901 SUCTION PIPING STRAIGHTENING VANE



NOTES:

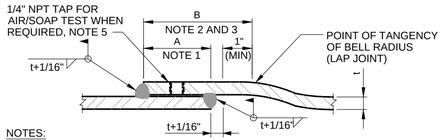
1. STRAIGHTENING VANES SHALL BE ROTATED 45 DEGREE FROM VERTICAL. THERE SHALL NOT BE A VANE AT THE INVERT OF THE PIPE.
2. LINING, COATING, INCLUDING FLANGES AND STRAIGHTENING VANES SHALL BE FUSION BONDED EPOXY LINED AND COATED.
3. 150LB FLANGE SHIPPED LOOSE. WELD IN FIELD TO SUIT ON PIPE UPSTREAM SIDE.
4. CONNECT WITH RESTRAINED FLANGE COUPLING ADAPTOR OR DISMANTLING JOINT AS SHOWN IN DRAWINGS.



NOTES:

1. LUG MATERIAL SHALL BE THE SAME AS THE PIPE MATERIAL.
2. LUGS SHALL BE PROVIDED BY THE PIPE SPOOL MANUFACTURER.
3. FIELD WELDED LUGS ARE PERMITTED SUBJECT TO ENGINEERS APPROVAL.
4. MAX LOAD 10,000 LBS
5. CONTRACTOR TO CONFIRM DIAMETER OF EXISTING CONCRETE OPENING BEFORE FABRICATING LUGS.
6. SEE DRAWING FOR LUG ORIENTATION.

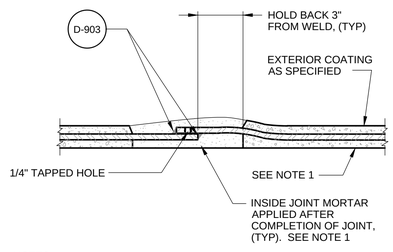
D-902 PIPE SUPPORT LUGS



NOTES:

1. DIMENSION "A" CORRESPONDS TO THE COMPLETED JOINT OVERLAP AFTER WELDING. DIMENSION "A" SHALL BE THE GREATER OF 3" OR 5t, MINIMUM.
2. FOR STANDARD JOINTS, THE MINIMUM DIMENSION "B" SHALL BE AS REQUIRED TO PROVIDE THE MINIMUM OVERLAP DIMENSION "A" AND MAINTAIN THE INDICATED HOLDBACK FOR THE WELD.
3. FOR SPECIAL TEMPERATURE CONTROL JOINTS, THE MINIMUM DIMENSION "B" SHALL BE INCREASED BY AT LEAST 3 INCHES. AT THE TIME OF INSTALLATION AND PRIOR TO WELDING, THE SPIGOT SHALL BE INSERTED INTO THE LENGTHENED BELL TO PROVIDE "A" +3 INCHES MINIMUM OVERLAP. SEE SPECIFICATIONS FOR SPECIAL TEMPERATURE CONTROL JOINT WELDING REQUIREMENTS.
4. FILLET WELDS FOR BELL AND SPIGOT LAP JOINTS SHOWN. FILLET WELDS ON OTHER JOINTS ARE SIMILAR.
5. CONTRACTOR MAY PUT TAP ON SPIGOT ID AT HIS DISCRETION.
6. THE JOINTS SHALL BE FABRICATED AND INSTALLED TO BE WITHIN THE TOLERANCES INDICATED. THE TOLERANCE REQUIREMENTS SHALL APPLY TO BOTH WELDS AND TO BOTH STRAIGHT AND DEFLECTED JOINTS.

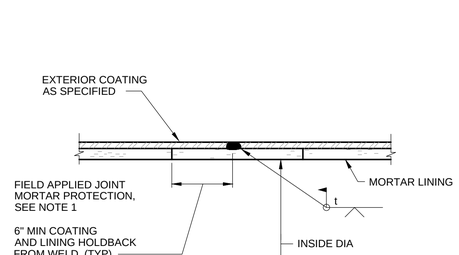
D-903 LAP JOINT WELD



NOTES:

1. SHOP APPLIED CEMENT MORTAR LINING SHOWN.
2. CONTRACTOR SHALL CONDUCT AN AIR/SOAP SOLUTION LEAK TEST AT 40 PSI AIR PRESSURE IN ADDITION TO DYE PENETRANT OR MAGNETIC PARTICLE TESTING PERFORMED BY THE CONSTRUCTION MANAGER. IF LEAKS ARE DETECTED, REPAIR AND RETEST THE WELDS UNTIL THERE ARE NO DEFECTS. PLUG HOLES WITH A THREADED OR WELDED PLUG AT COMPLETION OF TEST AND COAT AS SHOWN. TAP HOLES MAY BE ON INSIDE OR OUTSIDE OF JOINT.

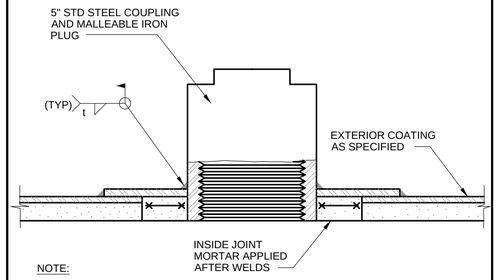
D-904 LAP WELDED SLIP JOINT
(WSP - CML)



NOTE:

1. FIELD APPLIED JOINT MORTAR PROTECTION REQUIRED FOR SHOP-LINED PIPE. PROVIDE CONTINUOUS LINING OVER JOINTS WHEN PIPE IS LINED IN THE FIELD.

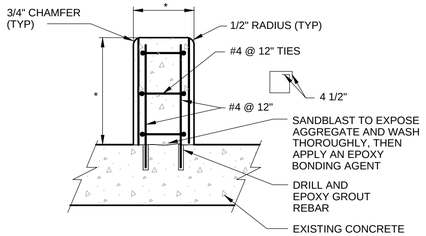
D-905 BUTT WELD
(WSP - CML)



NOTE:

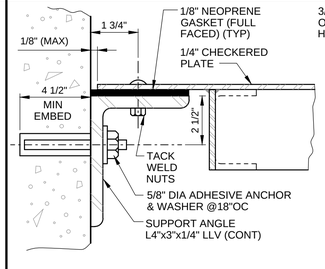
1. CONTRACTOR SHALL COORDINATE SPACING/LOCATION OF HANDHOLE WITH PIPE SUPPLIER.

D-906 HANDHOLE FOR WSP
(REQUIRED ON PIPE SMALLER THAN OR EQUAL TO 24" DIAMETER)



PIER OVER EXISTING SLAB

D-907 CONCRETE PIER FOR PIPE SUPPORT



WALL MOUNTED SUPPORT ANGLE
(USE ONLY WHERE CAST-IN FRAME CANNOT BE USED)

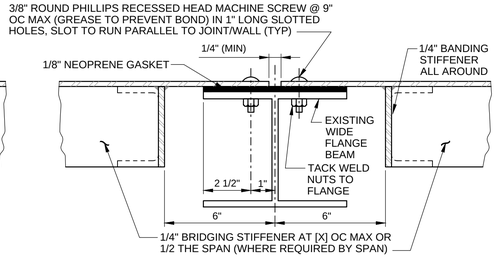


PLATE JOINT DETAIL

MATERIAL	LOADING (PSF)	X MAX (IN)	MAXIMUM SPAN OF OPENING (FEET)				
			STIFFENER SIZE 1/4"xH				
			2"	3"	C4x2.331	C5x3.089	C6x4.030
ALUMINUM	100	25	4.5	5.5	6	7	8
	150	25	3.5	4.5	5.5	6.5	7.5
	200	20	3.5	4.5	5.5	6.5	7
	250	20	3	4	5	6	7
	300	20	3	3.5	5.0	5.5	6.5

MATERIAL	LOADING (PSF)	X MAX (IN)	MAXIMUM SPAN OF OPENING (FEET)						
			STIFFENER SIZE 1/4"xH						
			2"	3"	4"	5"	C6x8.2	C7x9.8	C8x11.5
STEEL	100	40	4.5	6	7	8.5	12	14	15.5
	150	35	4	5	6	7.5	11.5	13	14.5
	200	30	3.5	4.5	5.5	7	11	12.5	14
	250	30	3	4	5	6	10.5	12	13
	300	30	3	4	4.5	5.5	10	11.5	12.5

**
NOTES:

1. CHKD PLATE COVERS SHALL BE ALUMINUM UNLESS INDICATED OTHERWISE.
2. MAX WEIGHT OF PLATE COVER = 80 LBS.
3. MATERIALS:

PLATE COVER MATERIAL	SUPPORT ANGLE	ANGLE FRAME	WELDED STUDS	ADHESIVE ANCHORS	SPLICE PLATE	NUTS AND BOLTS
GALV STEEL	GALV STEEL	GALV STEEL	GALV STEEL, 1/2" DIA x4" @12" OC MAX	ASTM F1554 GR 36, GALV	GALV STEEL	GALV STEEL

4. ALL GALVANIZED MATERIAL TO BE GALVANIZED AFTER FABRICATION.
5. NOT USED.
6. ALUMINUM IN CONTACT WITH CONCRETE SHALL BE COATED PER THE PROTECTIVE COATING SPECIFICATIONS.
7. NOT ALL MATERIAL TYPES MAY BE USED ON A SINGLE PROJECT.
8. "X" = MAXIMUM SPAN OF UNSTIFFENED PLATE COVER.

D-908 PLATE COVERED OPENING

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CLACKAMAS WATER ENVIRONMENT SERVICES

Revision	By	Appd	YYYY.MM.DD
0 FOR CONSTRUCTION	LS	HS	2021.11.23

Issued	By	Appd	YYYY.MM.DD
A 30% PROGRESS PRINTS	LS	HS	2021.05.24
B 90% PROGRESS PRINTS	LS	HS	2021.08.11

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 58599 OREGON JULY 21, 1995 HEATHER M. STEPHENS
EXPIRATION DATE: 6/30/22

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

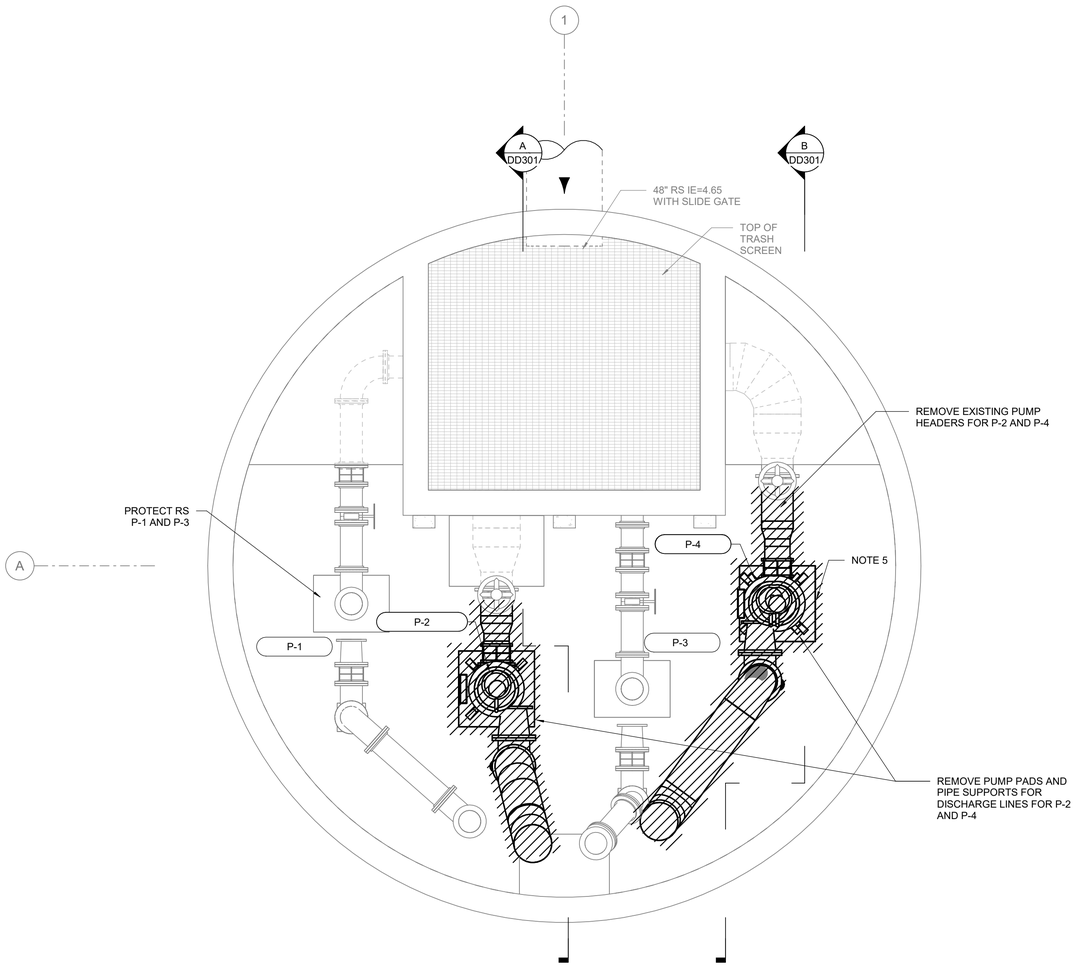
Project No.: 2002006172
File Name: 06172D-003
Scale: NO SCALE

MT	LS	GT	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
STANDARD DETAILS - II

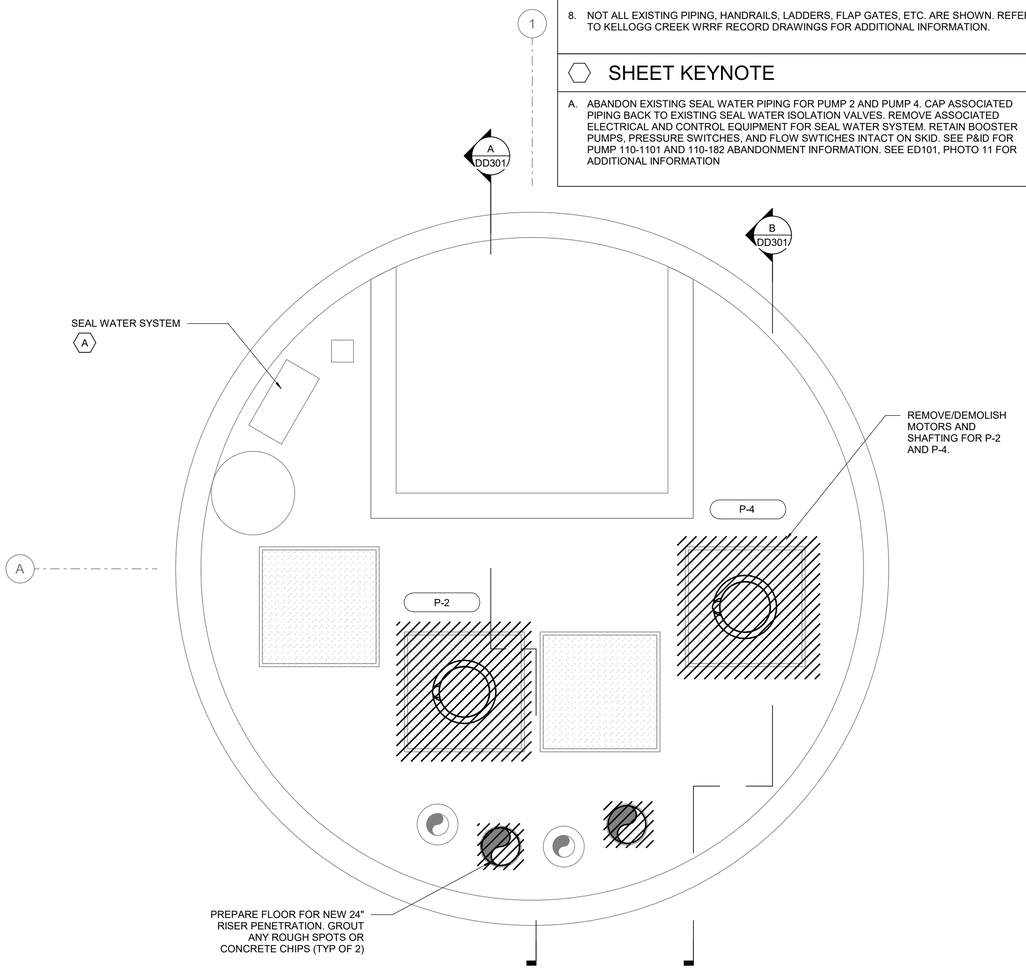
Revision:
Drawing No.
D-003

ORIGINAL SHEET - ANSI D



PUMP FLOOR PLAN AT EL -1.33'

SCALE: 1/4" = 1'-0"



MOTOR FLOOR PLAN AT EL 13.75'

SCALE: 1/4" = 1'-0"

GENERAL SHEET NOTES

1. REFER TO SECTION 02 41 19 DEMOLITION AND RECONSTRUCTION FOR ADDITIONAL REQUIREMENTS.
2. REMOVE PUMP NO 2 AND NO 4 AND ASSOCIATED PIPING DOWNSTREAM OF SUCTION INLET GATE VALVE TO LOWER PORTION OF HARNESSED SLEEVE COUPLINGS ON 24" WELDED STEEL DISCHARGE HEADER.
3. REMOVE ASSOCIATED SUPPORTS AND PEDESTALS SO THAT NEW ONES CAN BE INSTALLED TO SUPPORT PUMPS.
4. PROTECT ALL EQUIPMENT NOT SPECIFICALLY MARKED FOR DEMOLITION.
5. HVAC DUCT WORK IN THE VICINITY OF THE ACCESS HATCH FOR PUMP 4 MUST BE TEMPORARILY REMOVED AND THEN REINSTALLED AFTER NEW PUMP IS IN PLACE. PROVIDE TEMPORARY AIR HANDLING UNITS TO ENSURE MINIMUM OF 12 AIR CHANGES PER HOUR IN ALL AREAS OF PUMP STATION. REINSTALL DUCTWORK FOLLOWING COMPLETION OF PUMP INSTALLATION.
6. EXISTING 3 TON BRIDGE CRANE IS AVAILABLE TO ASSIST WITH REMOVAL OF EQUIPMENT SLATED FOR DEMOLITION.
7. ALL PUMP STATION PUMPING OPERATIONS AND FUNCTIONALITY MUST BE MAINTAINED DURING CONSTRUCTION. PROVIDE BACK UP PUMPING CAPABILITIES AS NEEDED TO ENSURE CONTINUOUS PUMP STATION OPERATION. REFER TO SECTION 01 14 00. CONSTRUCTION CONSTRANTS ONE LARGE OR ONE SMALL PUMP MAY BE OFF-LINE AT ANY GIVEN TIME.
8. NOT ALL EXISTING PIPING, HANDRAILS, LADDERS, FLAP GATES, ETC. ARE SHOWN. REFER TO KELLOGG CREEK WRRF RECORD DRAWINGS FOR ADDITIONAL INFORMATION.

SHEET KEYNOTE

A. ABANDON EXISTING SEAL WATER PIPING FOR PUMP 2 AND PUMP 4. CAP ASSOCIATED PIPING BACK TO EXISTING SEAL WATER ISOLATION VALVES. REMOVE ASSOCIATED ELECTRICAL AND CONTROL EQUIPMENT FOR SEAL WATER SYSTEM. RETAIN BOOSTER PUMPS, PRESSURE SWITCHES, AND FLOW SWTICHES INTACT ON SKID. SEE P&ID FOR PUMP 110-1101 AND 110-182 ABANDONMENT INFORMATION. SEE ED101, PHOTO 11 FOR ADDITIONAL INFORMATION

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CLACKAMAS WATER ENVIRONMENT SERVICES

Revision	By	Appd	YYYY.MM.DD
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A 30% PROGRESS PRINTS	LS	HS	2021.05.24
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REGISTERED PROFESSIONAL ENGINEER 58599 OREGON JULY 21, 1998 HEATHER M. STEPHENS

EXPIRATION DATE: 6/30

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.:2002006172
File Name: N/A
Scale: 1/4" = 1'-0"

REM	LS	2021.11.23
Dwn.	Dsgn.	Chkd. YYYY.MM.DD

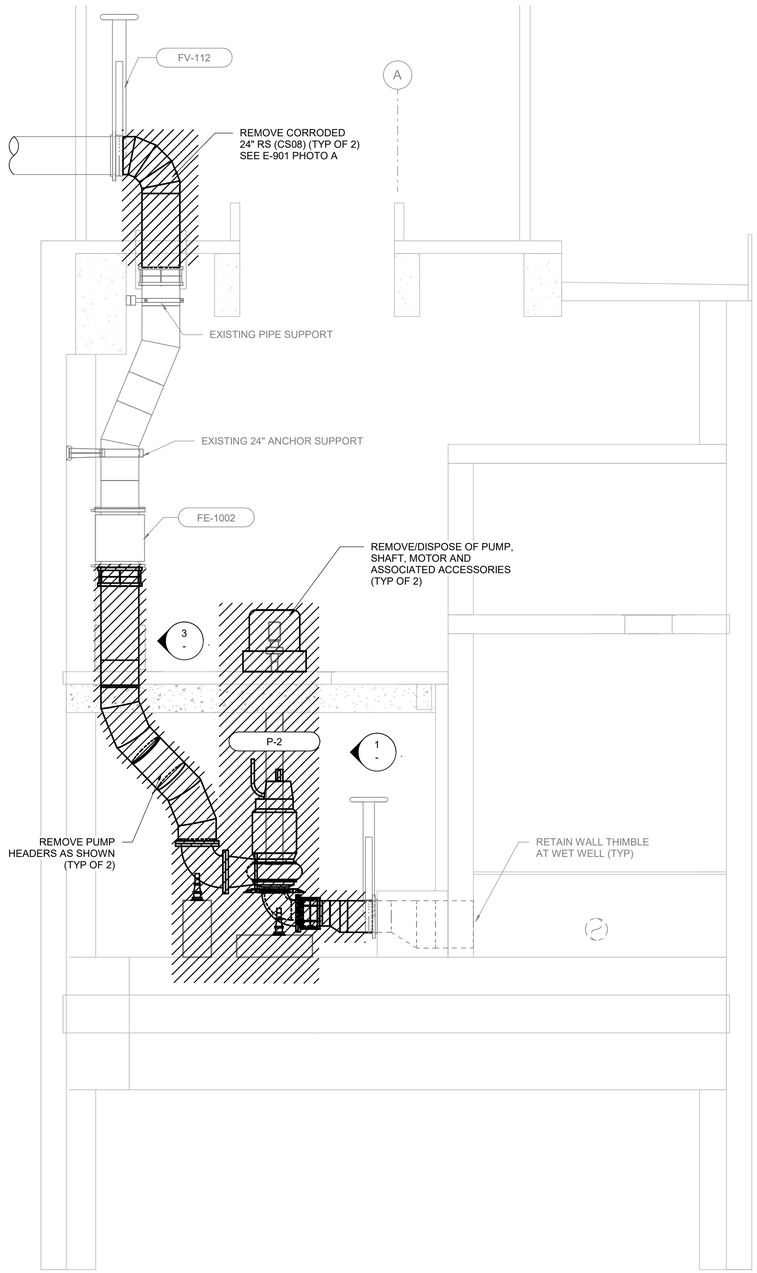
Title
DEMOLITION
PUMP STATION
WET WELL PLANS

Revision:

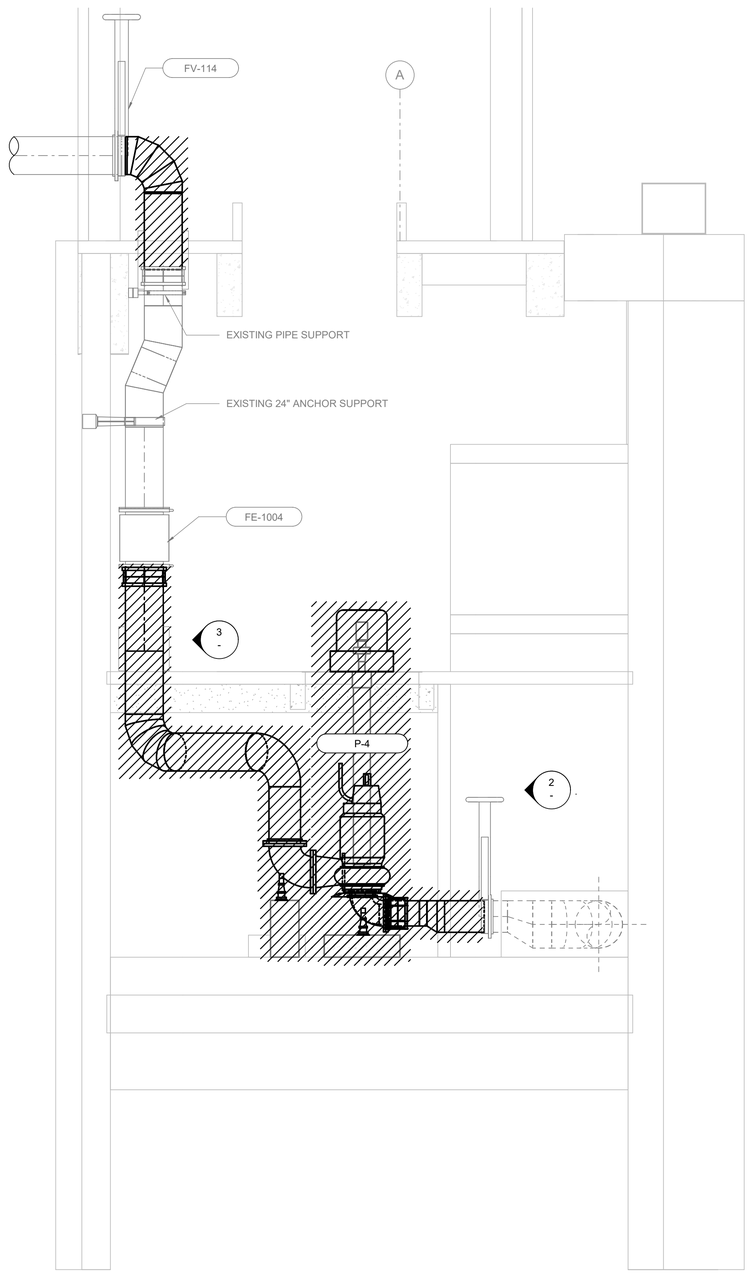
Drawing No.
DD101

11/19/2021 11:10:35 AM

ORIGINAL SHEET - ANSI D



A DD101 SECTION PUMP 2
SCALE: 1/4" = 1'-0"



B DD101 SECTION PUMP 4
SCALE: 1/4" = 1'-0"

GENERAL SHEET NOTES

1. REFER TO SECTION 02 41 19 DEMOLITION AND RECONSTRUCTION FOR ADDITIONAL REQUIREMENTS.
2. REMOVE PUMP NO 2 AND NO 4 AND ASSOCIATED PIPING DOWNSTREAM OF SUCTION INLET GATE VALVE TO LOWER PORTION OF HARNESSED SLEEVE COUPLINGS ON 24" WELDED STEEL DISCHARGE HEADER.
3. REMOVE ASSOCIATED SUPPORTS AND PEDESTALS SO THAT NEW ONES CAN BE INSTALLED TO SUPPORT PUMPS.
4. PROTECT ALL EQUIPMENT NOT SPECIFICALLY MARKED FOR DEMOLITION.
5. HVAC DUCT WORK IN THE VICINITY OF THE ACCESS HATCH FOR PUMP NO 4 MUST BE TEMPORARILY REMOVED AND THEN REINSTALLED AFTER NEW PUMP IS IN PLACE. PROVIDE TEMPORARY AIR HANDLING UNITS TO ENSURE MINIMUM OF 12 AIR CHANGES PER HOUR IN ALL AREAS OF PUMP STATION. REINSTALL DUCTWORK FOLLOWING COMPLETION OF PUMP INSTALLATION. SEE SECTION 01 14 00.
6. ALL PUMP STATION PUMPING OPERATIONS AND FUNCTIONALITY MUST BE MAINTAINED DURING CONSTRUCTION. PROVIDE BACK UP PUMPING CAPABILITIES AS NEEDED TO ENSURE CONTINUOUS PUMP STATION OPERATION. SEE SECTION 01 14 00.
7. DEMOLISH EXISTING SEAL WATER PIPING FOR PUMP NO. 2 AND PUMP NO. 4. REMOVE ALL ASSOCIATED PIPING BACK TO EXISTING SEAL WATER ISOLATION VALVES. REMOVE ASSOCIATED ELECTRICAL AND CONTROL EQUIPMENT FOR SEAL WATER SYSTEM.
8. REMOVE PUMPS/EQUIPMENT LISTED FOR SALVAGE, THEN DEMOLISH REMANING PIPING AND EQUIPMENT SUPPORTS.
9. PATCH CONCRETE DAMAGED OR IMPACTED BY EQUIPMENT REMOVAL AS REQUIRED IN SECTION 02 41 19.
10. NOT ALL EXISTING PIPING, HANDRAILS, LADDERS, FLAP GATES, ETC. ARE SHOWN. REFER TO KELLOGG CREEK WRRF RECORD DRAWINGS FOR ADDITIONAL INFORMATION.

1 DEMO - PUMP 2
NO SCALE

2 DEMO - PUMP 2 AND 4
NO SCALE

3 DEMO - DISCHARGE
NO SCALE

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CLACKAMAS WATER ENVIRONMENT SERVICES

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Permit/Seal

REGISTERED PROFESSIONAL ENGINEER
58599
OREGON
JULY 21, 1999
HEATHER M. STEPHENS
EXPIRATION DATE: 6/30/22

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.:2002006172
File Name: N/A
Scale: AS SHOWN

REM.	LS		2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
DEMOLITION
PUMP STATION
WET WELL SECTIONS - I

Revision:
Drawing No.
DD301

11/19/2021 11:11:21 AM

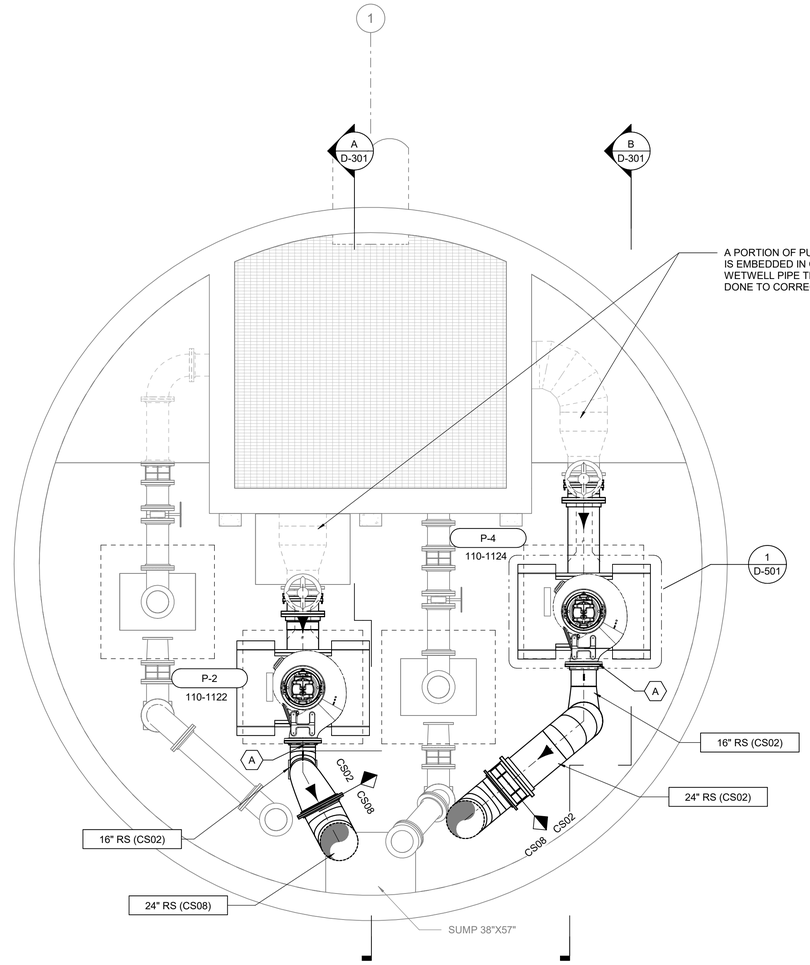
ORIGINAL SHEET - ANSI D

GENERAL SHEET NOTE

1. PATCH CONCRETE DAMAGED OR IMPACTED BY EQUIPMENT REMOVAL AS REQUIRED IN SECTION 02 41 19.

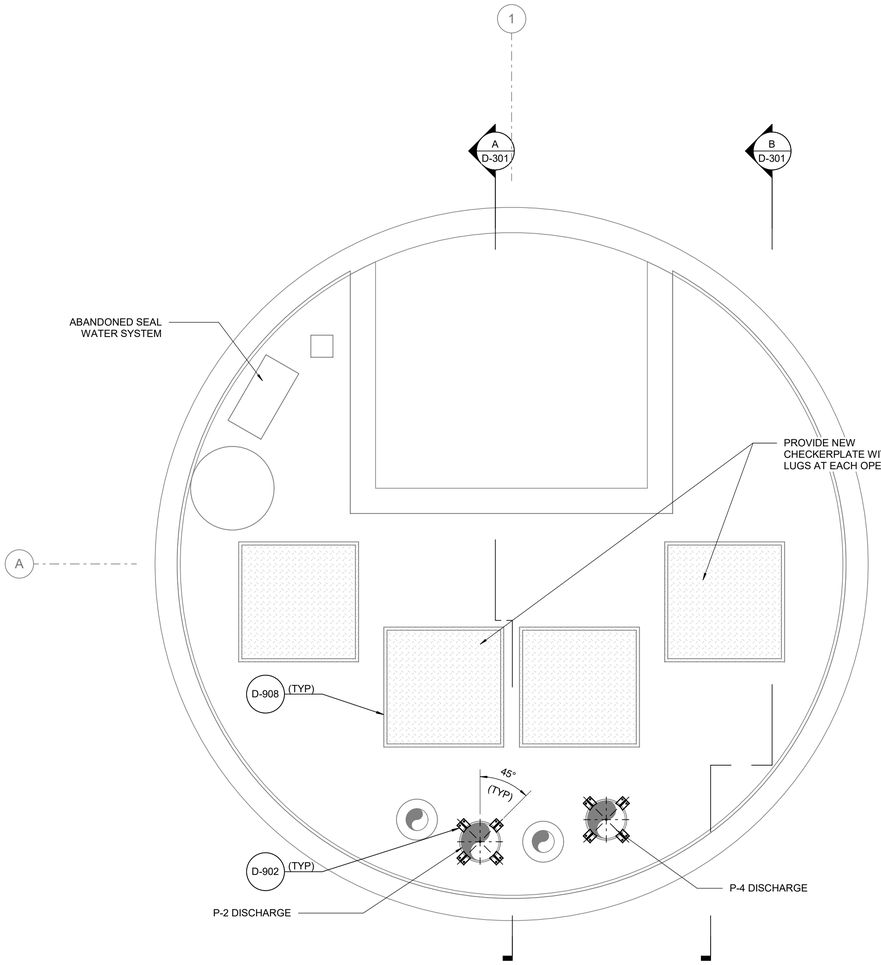
SHEET KEYNOTE

A. PROVIDE EXTRA THICK EPDM RUBBER GASKETS AT P-2 AND P-4 DISCHARGE FLANGES.



PUMP FLOOR PLAN AT EL -1.33'

SCALE: 1/4" = 1'-0"



MOTOR FLOOR PLAN AT EL 13.75'

SCALE: 1/4" = 1'-0"

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CLACKAMAS WATER ENVIRONMENT SERVICES

By	Appd	YYYY.MM.DD	Revision
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LS	HS	2021.08.11	B 90% PROGRESS PRINGS
LS	HS	2021.05.24	A 30% PROGRESS PRINGS

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 58599 OREGON JULY 21, 1989 HEATHER M. STEPHENS

EXPIRATION DATE: 6/30/22

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES

KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT

Clackamas County, Oregon

Project No.:2002006172

File Name: N/A

Scale: 1/4" = 1'-0"

MT	LS		2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

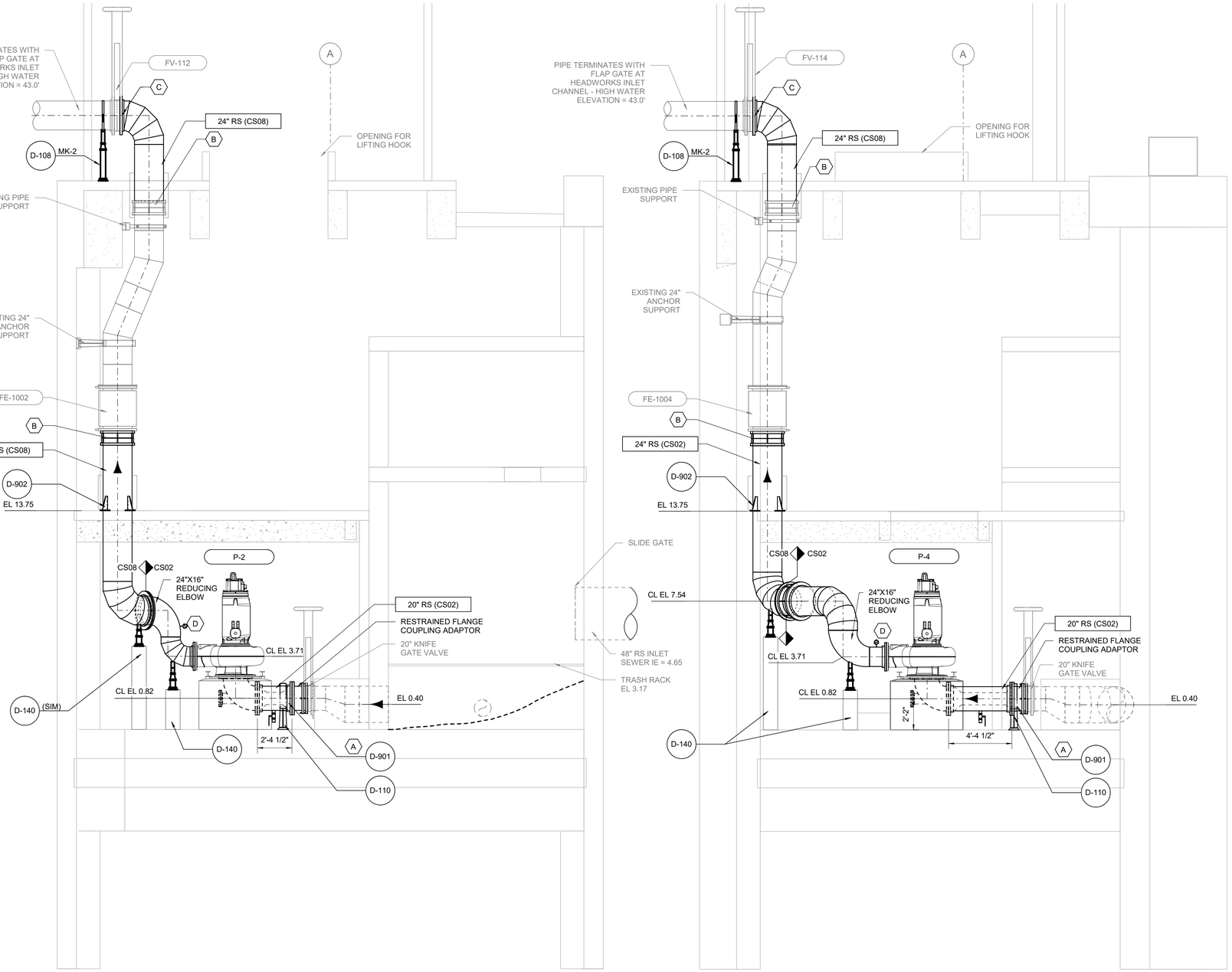
Title
PUMP STATION
WET WELL PLANS

Revision:

Drawing No.
D-101

11/19/2021 11:09:55 AM

ORIGINAL SHEET - ANSI D



A D-101 SECTION
SCALE: 1/4" = 1'-0"

B D-101 SECTION
SCALE: 1/4" = 1'-0"

GENERAL SHEET NOTES

1. NOT ALL EXISTING PIPING, HANDRAILS, LADDERS, FLAP GATES, ETC. ARE SHOWN. REFER TO KELLOGG CREEK WPCP RECORD DRAWINGS FOR ADDITIONAL INFORMATION. CONTRACTOR TO CONFIRM ALL DIMENSIONS OF EXISTING FACILITY PRIOR TO ORDERING PIPE AND EQUIPMENT.
2. RATED CAPACITY OF EXISTING BRIDGE CRANE IS 3 TONS (6000 LBS). NEW PUMP MOTOR AND IMPELLER WILL NEED TO BE DISASSEMBLED FROM PUMP VOLUTE BEFORE LOWERING TO INSTALL AT PUMP STATION LOWER LEVEL.
3. STEEL FLANGES ON PUMP DISCHARGE PIPING MAY BE SHIPPED LOOSE AND FIELD WELDED TO SUIT.
4. CONTRACTOR SHALL ALIGN PUMP AND MOTOR USING LASER ALIGNMENT TOOLS TO ENSURE VIBRATION OF FINAL INSTALLATION IS MINIMIZED.
5. COAT EXTERIOR OF ALL EXISTING 24" RS DISCHARGE PIPE FOR PUMP P-2 AND P-4 TO MATCH NEW PIPE. SEE SECTION 09 96 00 FOR REQUIRED COATING AND PREPARATION.
6. PUMP SUCTION PIPING SHALL BE FUSION BONDED EPOXY LINED AND COATED IN ACCORDANCE WITH SECTION 09 96 00. PUMP DISCHARGE PIPING SHALL BE CEMENT MORTAR LINED PER SECTION 33 92 10, AWWA M-11, AND AWWA C205.
7. PROVIDE HANDHOLES AS NEEDED TO REPAIR PIPE LININGS FOLLOWING FIELD WELDS.

SHEET KEYNOTES

A. PROVIDE RESTRAINED FLANGED COUPLING ADAPTOR OR DISMANTLING JOINT AND A CUSTOM FABRICATED SPOOL PIECE WITH STRAIGHTENING VANES. SEE DETAIL D-901 FOR INFORMATION ON CUSTOM SPOOL PIECE.

B. INTERFACE OF NEW PIPE AND EXISTING. CONTRACTOR TO CONFIRM DIMENSIONS OF EXISTING FLANGES AND COUPLINGS IN ORDER TO MAKE CONNECTIONS. PROVIDE NEW SLEEVE COUPLINGS WITH HARNESS AND BOLTS.

C. REPLACE 24" CORRODED WELDED STEEL PIPE.

D. PROVIDE PIPE CONNECTION PER DETAIL D-120 AND PRESSURE GAUGE PER SECTION 40 91 09

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0	FOR CONSTRUCTION	LS	HS	2021.11.23
B	90% PROGRESS PRINGS	LS	HS	2021.08.11
A	30% PROGRESS PRINGS	LS	HS	2021.05.24

Issued

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER
58599
OREGON
JULY 21, 1989
HEATHER M. STEPHENS
EXPIRATION DATE: 6/30/22

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

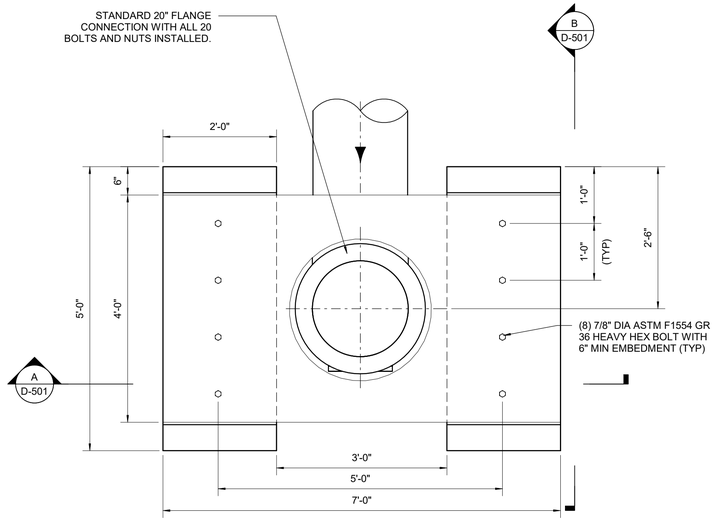
Project No.:2002006172
File Name: N/A
Scale: 1/4" = 1'-0"

MT	LS		2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
PUMP STATION
WET WELL SECTIONS - I

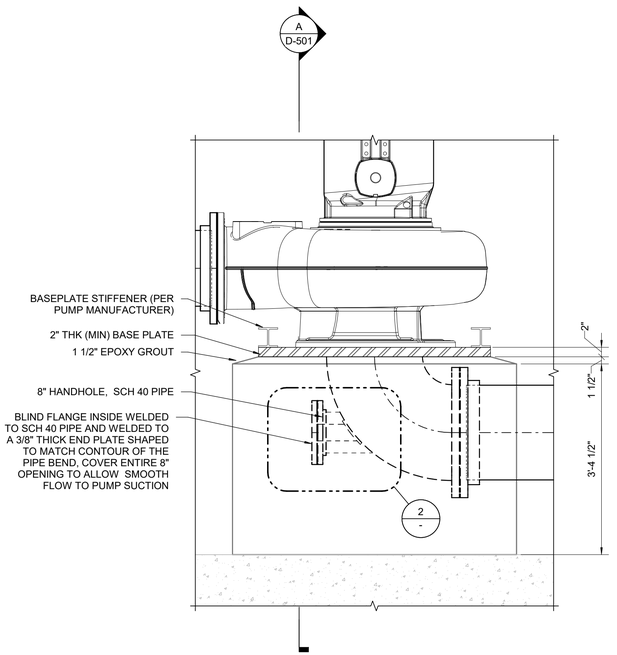
Revision:
Drawing No.
D-301

11/19/2021 11:10:14 AM
ORIGINAL SHEET - ANSI D



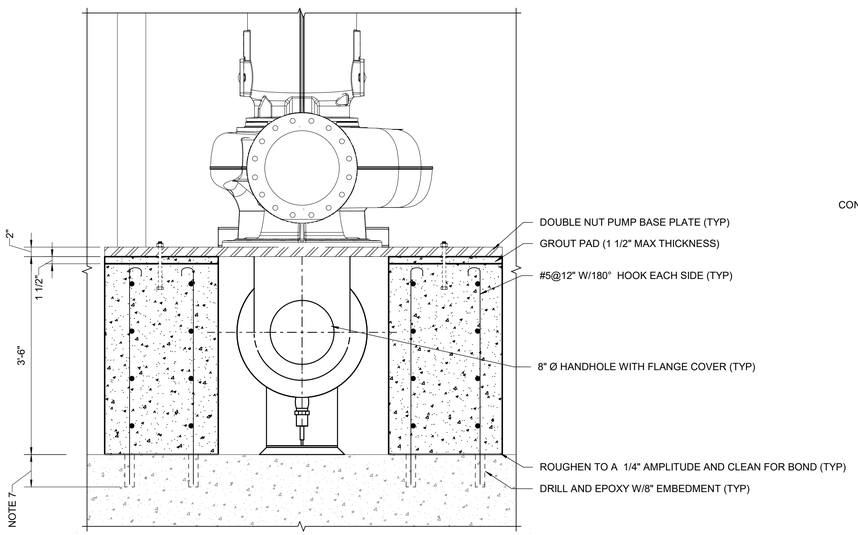
1 PUMP SUPPORT DETAIL - PLAN

SCALE: 3/4" = 1'-0"



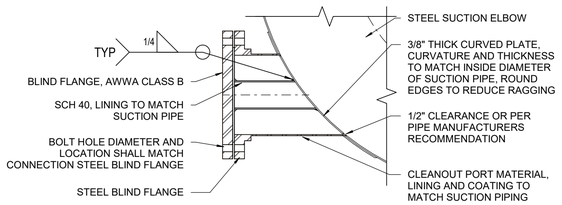
B D-501 PUMP SUPPORT ELEVATION - SIDE

SCALE: 3/4" = 1'-0"



A D-501 PUMP SUPPORT ELEVATION - END

SCALE: 3/4" = 1'-0"



2 D-501 DETAIL

SCALE: 1 1/2" = 1'-0"

GENERAL SHEET NOTES

1. PUMP MANUFACTURER SHALL CONFIRM BASEPLATE STIFFENERS ARE DESIGNED TO MEET PERFORMANCE SPECIFICATIONS FOR VIBRATION. SEE SPEC.
2. MACHINE SURFACES IN CONTACT WITH PUMP FLANGE RING.
3. CONTRACTOR TO FIELD VERIFY ALL DIMENSIONS, INCLUDING PUMP INLET LOCATION AND ELEVATION, PUMP OUTLET LOCATION AND ELEVATION AND EXISTING FLOOR PENETRATION LOCATION.
4. GENERAL PUMP LOCATION AND PIPING LAYOUT IS SHOWN. CONTRACTOR TO LAYOUT PUMP AND PIPING SO AS TO MAXIMIZE HORIZONTAL CLEARANCE FROM ADJACENT STRUCTURES AND EQUIPMENT.
5. VERIFY PUMP SUPPORT PIER DIMENSIONS WITH APPROVED SHOP DRAWINGS.
6. PUMP SUCTION PIPING SHALL BE EPOXY-LINED, EPOXY-COATED. SEE SPECIFICATION 09 96 00 FOR LINING REQUIREMENTS.
7. CONTRACTOR IS TO LOCATE ALL REINFORCING STEEL IN THE EXISTING CONCRETE FOR AVOIDANCE PRIOR TO DRILLING HOLES FOR EPOXY DOWELS. DO NOT DRILL INTO ANY REINFORCING STEEL. ANY ABANDONED HOLES ARE TO BE FILLED WITH EPOXY.

CONCRETE CONSTRUCTION (1704.4)

VERIFICATION AND INSPECTION	INSPECTIONS		REFERENCED STANDARDS
	CONTINUOUS	PERIODIC	
INSPECTION OF REINFORCING STEEL, INCLUDING PRESTRESSING TENDONS AND PLACEMENT	-	X	ACI 318 - 25.1 -25.9, 26.1 IBC 1907.1, 1907.7 AND 1913.4
INSPECT COLTS TO BE INSTALLED IN CONCRETE PRIOR TO AND DURING PLACEMENT OF CONCRETE	X	-	ACI 318 - 17.1.2, 26.7 IBC 1911.5, 1912.1
VERIFYING USE OF REQUIRED DESIGN MIX	-	X	ACI 318 - 26.4 IBC 1904, 1905.2 - 1905.4, 1913.2, 1912.3 AND 1914.2
SAMPLING FRESH CONCRETE AND PERFORMING SLUMP, AIR CONTENT AND DETERMINING THE TEMPERATURE OF FRESH CONCRETE AT THE TIME OF MAKING SPECIMENS FOR STRENGTH TESTS	X	-	ASTM C 172 ASTM C 31 ACI 318 - 19.3 AND 26.12 IBC 1905.6 AND 1913.10
INSPECTION OF CONCRETE AND SHOTCRETE PLACEMENT FOR PROPER APPLICATION TECHNIQUES	X	-	ACI 318 - 19.3 AND 26.12 IBC 1905.9, 1905.10, 1913.6, 1913.7, 1913.8
INSPECTION FOR MAINTENANCE OF SPECIFIED CURING TEMPERATURE AND TECHNIQUES	-	X	ACI 318 - 26.5, 26.12, 26.13 IBC 1905.11, 1905.13 AND 1913.9
POST INSTALLED ANCHOR INSTALLATION	X	-	PER ICC AND IAPMO REPORT
INSPECT FORMWORK FOR SHAPE, LOCATION AND DIMENSIONS OF THE CONCRETE MEMBER BEING FORMED	-	X	ACI 318 - 26.11

EARTHQUAKE DESIGN DATA

	2019 OSSC CODE VALUES
RISK CATEGORY	III
SEISMIC IMPORTANCE FACTOR (Ie)	1.25
COMPONENT IMPORTANCE FACTOR (Ip)	1.0
MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIODS (0.2 SEC) - 5% DAMPING (Ss)	0.88g
MAPPED SPECTRAL RESPONSE ACCELERATION AT1 SECOND PERIOD 5% DAMPING (S1)	0.39g
SITE CLASS	D
SPECTRAL RESPONSE COEFFICIENT (Sds)	0.71
SPECTRAL RESPONSE COEFFICIENT (Sd1)	0.50
SEISMIC DESIGN CATEGORY	D
BASIC SEISMIC FORCE RESISTING SYSTEM	EQUIPMENT SUPPORT AND ATTACHMENT
DESIGN BASE SHEAR	2.98 KIPS
RESPONSE MODIFICATION COEFFICIENT (Rp)	2.5
COMPONENT AMPLIFICATION FACTOR (ap)	1.0
ANALYSIS PROCEDURE USED	EQUIVALENT LATERAL FORCE PROCEDURE

SPECIAL INSPECTION NOTES:

1. SPECIAL INSPECTIONS ARE REQUIRED IN ACCORDANCE WITH THE 2019 OSSC CHAPTER 17. THE OWNER WILL ENGAGE THE SERVICES OF A QUALIFIED SPECIAL INSPECTOR, WHO SHALL PROVIDE ALL SERVICE NECESSARY TO MEET THE OSSC SPECIAL INSPECTION REQUIREMENTS.

CONCRETE

CONCRETE POST EMBEDMENT SHALL ACHIEVE A 28 DAY STRENGTH OF 4500 PSI AND A MAXIMUM WATER TO CEMENT RATIO OF 0.45.

REINFORCEMENT STEEL SHALL BE DEFORMED BARS CONFORMING IN QUALITY TO THE REQUIREMENTS OF ASTM A706, "SPECIFICATIONS FOR DEFORMED BILLET-STEEL BARS FOR CONCRETE REINFORCEMENT", GRADE 60.

ALL DETAILING, FABRICATION AND PLACING OF REINFORCING BARS, UNLESS OTHERWISE INDICATED, SHALL BE IN ACCORDANCE WITH ACI-315, "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES", LATEST EDITION.

TOLERANCES IN PLACING REINFORCEMENT SHALL BE"
+/- 3/8 INCH FOR MEMBERS WITH DEPTH D </= 8 INCHES
+/- 1/2 INCH FOR MEMBERS WITH DEPTH D >8 INCHES

ALL CONSTRUCTION JOINTS, SHALL BE ROUGHENED TO A MINIMUM 1/4" AMPLITUDE AND THOROUGHLY CLEANED FOR BOND

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CLACKAMAS WATER ENVIRONMENT SERVICES

Issued	By	Appd	YYYY.MM.DD
0 FOR CONSTRUCTION	LS	HS	2021.11.23
A 30% PROGRESS PRINTS	LS	HS	2021.05.24
B 90% PROGRESS PRINTS	LS	HS	2021.08.11

Revision

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 58599 OREGON JULY 21, 1995 HEATHER M. STEPHENS

EXPIRATION DATE: 6/30/22

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.:2002006172
File Name: N/A

Scale: As indicated

MT	LS	GT	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
PUMP STATION DETAILS

Revision:

Drawing No.
D-501

11/19/2021 11:10:32 AM

ORIGINAL SHEET - ANSI D

SINGLE LINE DIAGRAM SYMBOLOGY

MEDIUM VOLTAGE VACUUM DRAWOUT STARTER

52 — MEDIUM VOLTAGE DRAWOUT BREAKER

THERMAL MAGNETIC CIRCUIT BREAKER
LOC = MCC COMPARTMENT LOCATION
= BLANK (FIELD MOUNTED)
LOC — 100 (FRAME (AMPS)) / 20 (TRIP (AMPS))

MCP CIRCUIT BREAKER
LOC = MCC COMPARTMENT LOCATION
= BLANK (FIELD MOUNTED)
LOC — 7 (CONTINUOUS AMPS) / MCP (TRIP SETTING BASED ON MOTOR HORSEPOWER)

LOW VOLTAGE DRAWOUT CIRCUIT BREAKER
800 / 400

(L-S-I-G)	
L	LONG TIME
S	SHORT TIME
I	INSTANTANEOUS
G	GROUND FAULT

COMBINATION NEMA RATED STARTER WITH MCP DISCONNECT AND CONTROL POWER TRANSFORMER
LOC — 40 / MCP
ROMAN NUMERAL = NEMA SIZE
LOC = MCC COMPARTMENT LOCATION
= BLANK (FIELD MOUNTED)
* = STARTER TYPE

(BLANK)	FULL VOLTAGE NON-REVERSING
FVR	FULL VOLTAGE REVERSING
2S2W	TWO SPEED TWO WINDING
2S1W	TWO SPEED ONE WINDING

X — VFD — VARIABLE FREQUENCY DRIVE
X = AMPERE RATING

X — RVSS — REDUCED VOLTAGE SOLID STATE STARTER
X = AMPERE RATING

X / Y — PACKAGED EQUIPMENT
X = EQUIPMENT SIZE
Y = TYPE (KW, KVA, OR HP AS INDICATED)

K — KEY INTERLOCK

GENERATOR
RATINGS AS INDICATED

TRANSFER SWITCH (MANUAL OR AUTOMATIC)
RATINGS AS INDICATED

AS — AMMETER SWITCH

VS — VOLTMETER SWITCH

X — METERING DEVICE
X = METER TYPE

WHM	WATT HOUR METER
WM	WATT METER
AM	AMMETER
VM	VOLTMETER
PFM	POWER FACTOR METER

480/120 / (3) — POTENTIAL TRANSFORMER
RATIO AND NUMBER OF PT'S AS INDICATED

100/5 (3) — CURRENT TRANSFORMER
RATIO AND NUMBER OF CT'S AS INDICATED

GROUND FAULT CURRENT TRANSFORMER
RATIO AS INDICATED

5A — FUSE
SIZE AS INDICATED

X* — MOTOR
X = HORSEPOWER
* = FULL LOAD AMPS

DELTA-WYE TRANSFORMER WITH
SECONDARY KVA SIZE AND VOLTAGE
RATIO AS INDICATED

X AMPS
Y SECONDS
51G — DELTA-WYE TRANSFORMER
WITH RESISTANCE GROUNDED
SECONDARY AND GROUND
FAULT RELAYING
X - GROUNDING RESISTOR AMPS
Y - GROUNDING RESISTOR SECONDS

FUSED CONTROL POWER TRANSFORMER

MOV — ELECTRICAL MOTOR OPERATED VALVE, WITH
INTEGRAL REVERSING STARTER

30A — DISCONNECT SWITCH
SIZE AS INDICATED

30A / 30A — FUSED DISCONNECT SWITCH
SIZE AS INDICATED

CAPACITOR

SPD — SURGE PROTECTIVE DEVICE

SSM — SOLID STATE METERING DEVICE

SSMP — SOLID STATE MOTOR PROTECTIVE DEVICE

LIGHTNING ARRESTOR AND SURGE CAPACITOR

ANSI RELAY DEVICE
(#) — (#) = QUANTITY
* = ANSI DEVICE

25	SYNCHRONISM CHECK RELAY
27	UNDERVOLTAGE
27/47	UNDERVOLTAGE, PHASE SEQUENCE, UNBALANCED VOLTAGE
32	DIRECTIONAL POWER RELAY
41	FIELD CONTACTOR
43	SELECTOR SWITCH
49	HIGH OIL TEMPERATURE
50/51	INSTANTANEOUS AND TIME OVERCURRENT
50/51N	INSTANTANEOUS AND TIME RESIDUALLY CONNECTED GROUND OVERCURRENT
51G	GROUND FAULT
60	VOLTAGE BALANCE
62	TIME DELAY
63	SUDDEN PRESSURE
67	AC DIRECTIONAL CURRENT RELAY
71L	LOW OIL LEVEL
81	FREQUENCY RELAY
83	CONTROL POWER TRANSFORMER
86	LOCKOUT
87TL	TRANSFORMER DIFFERENTIAL
87M	MOTOR DIFFERENTIAL

REV 010119

SCHEMATIC DIAGRAM SYMBOLOGY

L O R — THREE - POSITION SELECTOR SWITCH

L R — TWO - POSITION SELECTOR SWITCH

THREE - POSITION SPRING RETURN-TO-CENTER
MOMENTARY CONTACT SWITCH

SINGLE POLE TOGGLE SWITCH

VACUUM OR PRESSURE SWITCH
CLOSE ON RISING PRESSURE

VACUUM OR PRESSURE SWITCH
OPEN ON RISING PRESSURE

FLOAT LEVEL SWITCH
CLOSE ON RISING LEVEL

FLOAT LEVEL SWITCH
OPEN ON RISING LEVEL

NORMALLY OPEN

NORMALLY CLOSED

NORMALLY OPEN HELD CLOSED

NORMALLY CLOSED HELD OPEN

MAINTAINED POSITION

TEMPERATURE SWITCH
CLOSE ON RISING TEMPERATURE

TEMPERATURE SWITCH
OPEN ON RISING TEMPERATURE

FLOW SWITCH
CLOSE ON INCREASING FLOW

FLOW SWITCH
OPEN ON INCREASING FLOW

TORQUE SWITCH
OPEN ON INCREASING TORQUE

1 — LOCATION SYMBOL
LEGEND SHOWN ON SCHEMATIC DRAWINGS
ALL DEVICES ARE LOCATED IN THE MCC
UNLESS INDICATED OTHERWISE

DI — DIGITAL INPUT TO PLC/RTU/DCS

DIGITAL OUTPUT FROM PLC/RTU/DCS
NORMALLY OPEN

DIGITAL OUTPUT FROM PLC/RTU/DCS
NORMALLY CLOSED

AI — ANALOG INPUT TO PLC/RTU/DCS
4-20 mA (UNLESS INDICATED OTHERWISE)

AO — ANALOG OUTPUT FROM PLC/RTU/DCS
4-20 mA (UNLESS INDICATED OTHERWISE)

SV — SOLENOID VALVE

SOLENOID VALVE

E-STOP PUSHBUTTON

X — CONTROL RELAY OR COIL
X = DEVICE

CR	CONTROL RELAY
TD	TIME DELAY RELAY (TIMING RANGE AS INDICATED)
M	MOTOR STARTER
PC	PHOTOCELL

NORMALLY OPEN CONTACT

NORMALLY CLOSED CONTACT

XXXX — NORMALLY OPEN CONTACT LINE REFERENCE

XXXX — NORMALLY CLOSED CONTACT LINE REFERENCE

TIMED CONTACTS
CONTACT ACTION IS DELAYED AFTER COIL IS:

ENERGIZED

TD1 — NORMALLY OPEN WITH TIME DELAY CLOSING

TD1 — NORMALLY CLOSED WITH TIME DELAY OPENING

DE-ENERGIZED

TD1 — NORMALLY OPEN WITH INSTANT CLOSING AND TIME DELAY OPENING

TD1 — NORMALLY CLOSED WITH INSTANT OPENING AND TIME DELAY CLOSING

START — NORMALLY OPEN PUSHBUTTON

STOP — NORMALLY CLOSED PUSHBUTTON

OFF ON — NO/NC MAINTAINED PUSHBUTTON

X — PILOT LIGHT
X = LENS COLOR

R	RED
G	GREEN
A	AMBER
W	WHITE

X — PILOT LIGHT (PUSH-TO-TEST)
X = LENS COLOR (SEE ABOVE)

HORN

ETM — ELAPSED TIME METER

HEATER

GROUND CONNECTION

CROSSING OF CONDUCTORS - NOT CONNECTED

CROSSING OF CONDUCTORS - CONNECTED

FUSE

VOLTAGE SURGE SUPPRESSOR

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0.	FOR CONSTRUCTION	JDP	HS	2021.11.23
A.	90% PROGRESS PRINTS	JDP	HS	2021.08.31
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Issued

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 44408PE OREGON JAN. 12, 1995 JOHN C. DEERHOP

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172E-001

Scale: NO SCALE

MT	JDP	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
SYMBOLS - I

Revision:

Drawing No.
E-001

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ORIGINAL SHEET - ANSI D

PLAN SYMBOLOGY

CONDUIT AND RACEWAY SYMBOLOGY

- EXPOSED OR CONCEALED CONDUIT
- CONDUIT RUN (UNDERGROUND OR IN CONCRETE)
- CONDUIT RUN (CHANGE IN ELEVATION)
- CONDUIT TURNING UP
- CONDUIT TURNING DOWN
- CONDUITS GROUPED TOGETHER BUT SHOWN AS A SINGLE LINE FOR CLARITY
- CONDUIT FROM FLOOR ABOVE TO FLOOR BELOW
- CONDUIT CAPPED, OR SEALED
- HOMERUN TO EQUIPMENT INDICATED (3/4 " CONDUIT, 2 #12, 1 #12 GND UNLESS INDICATED OTHERWISE)
- RACEWAY BOX
  X = BOX TYPE
  - MH MANHOLE
  - HH HANDHOLE
  - PB PULLBOX
- JUNCTION BOX OR FITTING

GROUNDING SYMBOLOGY

- GROUND ROD AND GROUND WELL
- GROUND ROD (3/4" X 10'-0")
- GROUND CONNECTION - BOLTED TYPE
- GROUND CONNECTION - EXOTHERMIC TYPE
- BARE COPPER GROUND TO GROUND WIRE IN SLAB, OR UNDERGROUND GROUND GRID, SIZE AS NOTED
- EARTH GROUNDING

MISCELLANEOUS ELECTRICAL SYMBOLOGY

- POWER PANEL
- DISCONNECT SWITCH
- MOTOR
- THERMOSTAT
- HORN
- COMBINATION STARTER
- MANUAL MOTOR STARTER

REV 010119

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CLACKAMAS WATER ENVIRONMENT SERVICES

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0	FOR CONSTRUCTION	JDP	HS	2021.11.23
B	90% PROGRESS PRINTS	JDP	HS	2021.05.14
A	30% PROGRESS PRINTS	JDP	HS	2021.08.11

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Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 54440PE JAN. 12, 1988 JOHN C. DEERMOR

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172E-002

Scale: NO SCALE

MT	JDP	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
SYMBOLS - II

Revision:

Drawing No.
E-002

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ORIGINAL SHEET - ANSI D

ELECTRICAL ABBREVIATIONS

A	AMPERE, AUTOMATIC
AC	ALTERNATING CURRENT
AF	CIRCUIT BREAKER FRAME SIZE
AM	AMMETER
ANN	ANNUNCIATOR
AS	ADJUSTABLE SPEED
AT	AMPERE TRIP
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AWG	AMERICAN WIRE GAUGE
BATT	BATTERY
BC	BARE COPPER
BKR	BREAKER
C	CONDUIT, CLOSED
CAP	CAPACITOR
CB	CIRCUIT BREAKER
CKT	CIRCUIT
CLF	CURRENT LIMITING FUSE
COM	COMMON
COMM	COMMUNICATIONS
COMP	COMPARTMENT
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CR	CONTROL RELAY, CARD READER
CT	CURRENT TRANSFORMER
DCS	DISTRIBUTED CONTROL SYSTEM
DISC	DISCONNECT
DISTR	DISTRIBUTION
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
E	EMERGENCY
EMT	ELECTRICAL METALLIC TUBING
ENCL	ENCLOSURE
ETM	ELAPSED TIME METER
F	FREQUENCY, FUSE, FIXED
FDR	FEEDER
FLA	FULL LOAD AMPS
FLUOR	FLUORESCENT
FM	FREQUENCY METER
FO	FIBER OPTIC
FVR	FULL VOLTAGE REVERSING
FVNR	FULL VOLTAGE NON-REVERSING
GEN	GENERATOR
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
GND	GROUND
H	HAND
HD	HEAT DETECTOR
HH	HAND HOLE
HID	HIGH INTENSITY DISCHARGE
HOA	HAND-OFF-AUTOMATIC
HPS	HIGH PRESSURE SODIUM
HS	HAND SWITCH
HZ	HERTZ
IMC	INTERMEDIATE METALLIC CONDUIT
INCAND	INCANDESCENT
IND	INDICATION
INST	INSTANTANEOUS
I/O	INPUT/OUTPUT
Isc	SHORT CIRCUIT CURRENT, AMPS
ISO	ISOLATION
J, JB	JUNCTION BOX
KA	KILO AMPERES
KAIC	KILO AMP INTERRUPTING CURRENT
KCMIL	KILO CIRCULAR MILS
KVA	KILOVOLT AMPERE
L	LOCAL
LCP	LOCAL CONTROL PANEL
LCS	LOCAL CONTROL STATION
LOC	LOCAL
LOR	LOCAL-OFF-REMOTE
LOS	LOCKOUT STOP PUSHBUTTON
LP	LIGHTING PANEL
LRA	LOCKED ROTOR AMPS
LS	LEVEL SWITCH
LTG	LIGHTING
LTS	LIGHTS

M	MOTOR CONTACTOR COIL
mA	MILLIAMPERE
MCP	MOTOR CIRCUIT PROTECTOR
MLO	MAIN LUGS ONLY
MOV	MOTOR OPERATED VALVE
MS	MANUAL MOTOR STARTER
MTS	MANUAL TRANSFER SWITCH
NEUT	NEUTRAL
NP	NAMEPLATE
O	OPEN, OFF
OL	OVERLOAD
PA	PUBLIC ADDRESS
PB	PUSHBUTTON, PULLBOX
PC	PHOTOCELL
PCM	PROCESS CONTROL MODULE
PF	POWER FACTOR
PFM	POWER FACTOR METER
PH	PHASE
PL	PILOT LIGHT
PNLBD	PANELBOARD
PP	POWER PANELBOARD
POS	POSITION
POT	POTENTIOMETER
PRI	PRIMARY
PT	POTENTIAL TRANSFORMER
PTZ	PAN-TILT-ZOOM
PWR	POWER
R	REMOTE
RECPT	RECEPTACLE
RGS	RIGID GALVANIZED STEEL
RMS	ROOT MEAN SQUARE
RTU	REMOTE TERMINAL UNIT
RVSS	REDUCED VOLTAGE SOLID STATE
SEL SW	SELECTOR SWITCH
SEQ	SEQUENCE
SHLD	SHIELDED
SIG	SIGNAL
SP	SPARE
SP HTR	SPACE HEATER
SPDT	SINGLE POLE DOUBLE THROW
SPST	SINGLE POLE SINGLE THROW
SSM	SOLID STATE METER
SSMP	SOLID STATE MOTOR PROTECTOR
ST, SH	SHUNT TRIP
STR	STARTER
SSTU	SOLID STATE TRIP UNIT
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
TACH	TACHOMETER
TB	TERMINAL BOX
TERM	TERMINAL
TM	REPEAT CYCLE TIMER
TD	TIME DELAY RELAY
TS	TEMPERATURE SWITCH
UPS	UNINTERRUPTIBLE POWER SUPPLY
V	VOLTAGE, VOLTS
VA	VOLT AMPERE
VAR	VOLT AMPERE REACTIVE
VFD	VARIABLE FREQUENCY DRIVE
VM	VOLTMETER
VP	VAPOR PROOF
W	WATTS, WIRE
WM	WATT METER
WP	WEATHERPROOF
XFMR	TRANSFORMER
XMTR	TRANSMITTER
XP	EXPLOSION PROOF

REV 010119

GENERAL ELECTRICAL NOTES

1. ALL RACEWAYS AND EQUIPMENT SHALL BE INSTALLED AND GROUNDED IN ACCORDANCE WITH THE 2020 EDITION OF THE NATIONAL ELECTRICAL CODE AND APPLICABLE LOCAL CODES.
2. THE CONTRACTOR SHALL VERIFY THE EXACT LOCATION OF TERMINAL BOXES AND CONDUIT ENTRANCES OF ALL EQUIPMENT AGAINST APPROVED SHOP DRAWINGS BEFORE STUBBING UP CONDUITS.
3. REFER TO SPECIFICATION SECTION 260533 FOR REQUIREMENTS RELATED TO FLEXIBLE CONDUIT INSTALLATION
4. CONDUIT STUB-UPS SHALL NOT BE MORE THAN 6 INCHES FROM THE CENTERLINE OF TERMINAL BOXES.
5. IN THE EVENT OF INTERFERENCE BETWEEN ELECTRICAL EQUIPMENT SHOWN ON THE DRAWINGS AND OTHER EQUIPMENT, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IN WRITING AND THE ENGINEER SHALL APPROVE PROPOSED CHANGES BEFORE THEY ARE MADE.
6. ALL SURFACE MOUNTED PANELS AND PANELBOARDS ON THE INTERIOR OF EXTERIOR WALLS ABOVE GRADE OR IN OTHER LOCATIONS CONSIDERED DAMP OR WET SHALL BE MOUNTED SO AS TO MAINTAIN A 1/4 INCH (MINIMUM) AIR SPACE BETWEEN THE ENCLOSURE AND THE WALL.
7. LOCATION OF PULLBOXES ARE APPROXIMATE. THE CONTRACTOR SHALL COORDINATE EXACT LOCATION WITH MECHANICAL PIPING AND SHALL BE 6 INCHES (MINIMUM) AWAY FROM MECHANICAL PIPING FLOW LINES.
8. ONLY MAJOR PULLBOXES ARE SHOWN. THE CONTRACTOR SHALL PROVIDE ADDITIONAL PULLBOXES WHERE REQUIRED TO MAKE A WORKABLE INSTALLATION.
9. THE WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE DETAILS WHETHER OR NOT THEY ARE REFERENCED ON THE DRAWINGS.
10. ALL CONDUIT RUNS CROSSING EXPANSION JOINTS SHALL HAVE EXPANSION OR EXPANSION AND DEFLECTION TYPE FITTINGS.
11. CONDUIT RUNS ARE SHOWN DIAGRAMMATICALLY ONLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT OR STRUCTURAL CONDITIONS. EXPOSED CONDUIT SHALL BE INSTALLED PARALLEL OR PERPENDICULAR TO BEAMS AND WALLS. REFER TO SPECIFICATION SECTION 260533.
12. THE WIRING DIAGRAMS, QUANTITY AND SIZE OF WIRES AND CONDUIT REPRESENT A SUGGESTED ARRANGEMENT BASED UPON SELECTED STANDARD COMPONENTS OF ELECTRICAL EQUIPMENT. MODIFICATIONS ACCEPTABLE TO THE ENGINEER MAY BE MADE BY THE CONTRACTOR TO ACCOMMODATE EQUIPMENT ACTUALLY PURCHASED. THE BASIC SEQUENCE AND METHOD OF CONTROL MUST BE MAINTAINED AS INDICATED ON THE DRAWINGS AND/OR SPECIFICATIONS.
13. CONNECTIONS BETWEEN RIGID CONDUIT AND MOTOR TERMINAL BOXES OR SIMILAR EQUIPMENT SUBJECT TO VIBRATION SHALL BE FLEXIBLE LIQUID-TIGHT CONDUIT.
14. CONDUITS SHALL BE TERMINATED SO AS TO PERMIT NEAT CONNECTION TO MOTORS AND OTHER EQUIPMENT.
15. CONDUITS FOR FUTURE EQUIPMENT OR EXTENSIONS SHALL BE TERMINATED AS SHOWN IN DETAIL OR AS SPECIFIED.
16. ALL MOTOR STARTER CONTROL POWER TRANSFORMERS SHALL BE SIZED TO PROVIDE SUFFICIENT VOLT-AMPERE CAPACITY FOR OPERATING ALL LOCAL AND REMOTE ELECTRICAL DEVICES ASSOCIATED WITH CONTROL OF THE MOTOR IN ADDITION TO THE STARTER COIL.
17. MOTOR CONTROL CENTERS AND ALL FREE STANDING PANELS SHALL BE SET ON CONCRETE HOUSEKEEPING PADS WITH LEVELING CHANNELS EMBEDDED IN THE PAD.
18. ELECTRICAL CONTRACTOR SHALL VISIT THE SITE PRIOR TO BIDDING THE PROJECT TO VERIFY THE SCOPE OF WORK WITH FIELD CONDITIONS. PARTICULAR ATTENTION SHOULD BE GIVEN TO NEW CONDUIT RUNS IN EXISTING BUILDINGS.
19. EQUIPMENT LOCKOUTS SHALL BE IN STRICT ACCORDANCE WITH OWNER'S REQUIREMENTS.

ELECTRICAL DEMOLITION NOTES

1. BIDDING CONTRACTORS SHALL VISIT THE SITE TO ASSESS THE SCOPE OF DEMOLITION, REMOVAL AND MODIFICATION WORK.
2. ELECTRICAL CONTRACTOR AND THE OWNER SHALL DE-ENERGIZE ALL WIRING PRIOR TO REMOVAL OF EQUIPMENT, DEVICES, MOTORS INSTRUMENTATION, CONTROL PANELS, ETC. CONTRACTOR SHALL OBTAIN PRIOR APPROVAL FROM THE OWNER.
3. EXPOSED RACEWAYS: REMOVE CONDUIT, WIRES, AND BOXES. PATCH TO MATCH EXISTING. FINISH-ALL OPENINGS IN WALLS AND FLOORS
4. CONCEALED CONDUITS IN THE SLAB: REMOVE EXISTING WIRES TO THE EXTENT POSSIBLE AND ABANDON CONDUITS IN THE SLAB. CUT CONDUIT FLUSH AND PATCH THE FLOOR TO MATCH EXISTING
5. CONTROL PANEL: ELECTRICAL CONTRACTOR SHALL DE-ENERGIZE AND REMOVE ALL CONDUIT AND WIRE AS DESCRIBED IN NOTE 2. CONTRACTOR SHALL REMOVE PANELS AS NOTED ON THE CONTRACT DRAWINGS. REFER TO NOTE 4 ABOVE FOR DISPOSITION OF ENCASED CONDUITS.
6. MOTOR CONTROL CENTERS: DISCONNECT AND REMOVE ALL CONDUITS AND WIRING TO EXISTING STARTERS AND/OR BREAKERS, PANELBOARDS, BRANCH CIRCUITS, INTERLOCKS AND STATUS WIRING WITHIN MCC. REFER TO SECTION 260000 FOR ADDITIONAL ELECTRICAL DEMOLITION AND REMOVAL REQUIREMENTS.

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
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No.	Issued	By	Appd	YYYY.MM.DD
B.	90% PROGRESS PRINTS	JDP	HS	2021.08.11
A.	30% PROGRESS PRINTS	JDP	HS	2021.05.14

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 84440PE JOHN C. DEERMOR JAN. 12, 1988

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172E-003

Scale: NO SCALE

MT	JDP	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
ABBREVIATIONS AND GENERAL NOTES

Revision:

Drawing No.
E-003

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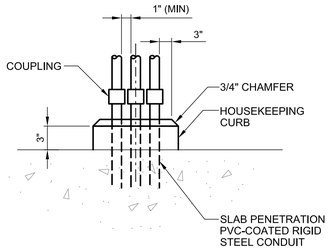
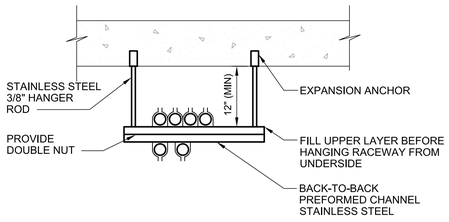
ORIGINAL SHEET - ANSI D

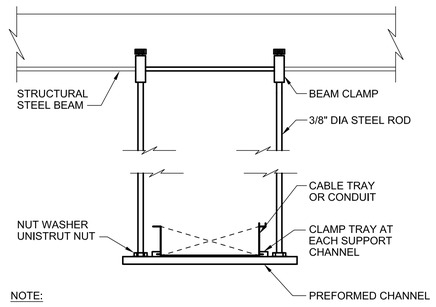


NOTE:
HOUSEKEEPING CURB REQUIRED AT ALL LOCATIONS FOR SINGLE AND MULTIPLE RISERS.

E-203 CONCRETE HOUSEKEEPING CURB
NON-HAZARDOUS LOCATIONS
REV 010119

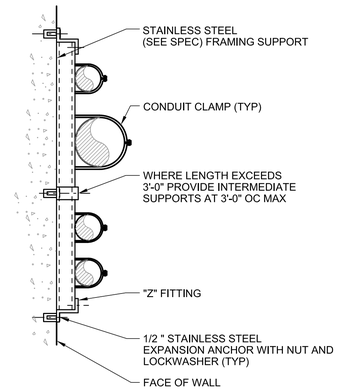


E-207 CONDUIT TRAPEZE
REV 010119

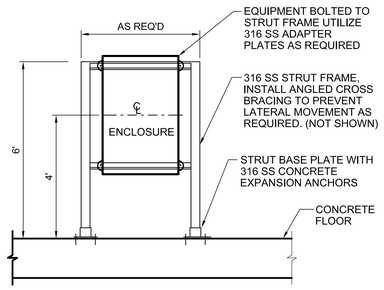


NOTE:
1. SPACING OF TRAY SUPPORTS SHALL BE NO MORE THAN MANUFACTURERS RECOMMENDATIONS AS SUBMITTED AND APPROVED BY ENGINEER.

E-208 TRAY OR CONDUIT HANGER
REV 010119



E-212 CONDUIT SUPPORT
FLUSH MOUNT
REV 010119



NOTE:
ALL NUTS, BOLTS, STUDS,WASHERS, ETC. SHALL BE 316 SS.

E-902 EQUIPMENT MOUNTING STAND
(TYP FOR EQUIPMENT MOUNTED WHERE BUILDING STRUCTURE OR WALLS ARE NOT AVAILABLE)

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CLACKAMAS WATER ENVIRONMENT SERVICES

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0	FOR CONSTRUCTION	JDP	HS	2021.11.23
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Issued

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 54440PE JAN. 12, 1988 JOHN C. DEERMOR

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

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File Name: 06172E-004
Scale: NO SCALE

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Title
STANDARD DETAILS - I

Revision:
Drawing No.
E-004

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ORIGINAL SHEET - ANSI D

B - PHOTOGRAPH 12 - ABANDONED 1000 KVA TRANSFORMER
NO SCALE

C - PHOTOGRAPH 13 - ABANDONED 1000 KVA TRANSFORMER
NO SCALE

A - PHOTOGRAPH 11 - SEAL WATER SYSTEM
ED-101 NO SCALE

ABANDON SEAL WATER SYSTEM. CAP FOUR SEAL WATER PIPES ON THE UNDERSIDE OF THIS EL 13.75' SLAB (ONE PIPE PER PUMP). REMOVE REMAINING PIPING WHICH EXTENDS TO EACH PUMP IN THE PUMP ROOM PLAN AT EL -1.33'. ABANDON ALL CONDUIT AND WIRE IN PLACE.

GENERAL SHEET NOTES

1. SEE SHEE E-103 FOR PUMP 2 AND PUMP 4 VFD REPLACEMENT REQUIREMENTS, AND PUMP 2 RTD RELAY ENCLOSURE DEMOLITION SCOPE.
2. NFPA 820 CLASSIFIED AREAS: PER 260000-1.6.A - ALL WORK TO BE PERFORMED UNDER THIS CONTRACT IS IN UNCLASSIFIED AREAS (PUMP ROOM, MOTOR LEVEL, GRADE FLOOR (VFD) LEVEL). THE WET WELL IS A CLASS 1 DIVISION 1 GROUP D AREA, BUT WORK IS NOT REQUIRED IN THE WET WELL UNDER THIS CONTRACT.
3. SEE PHOTOGRAPH 12 & 13 ON THIS SHEET FOR DEMOLITION SCOPE RELATED TO ABANDONED PAD MOUNT TRANSFORMER LOCATED SOUTHEAST OF INFLUENT PUMP STATION AT GRADE. (NOT SHOWN ON PLAN DRAWINGS)

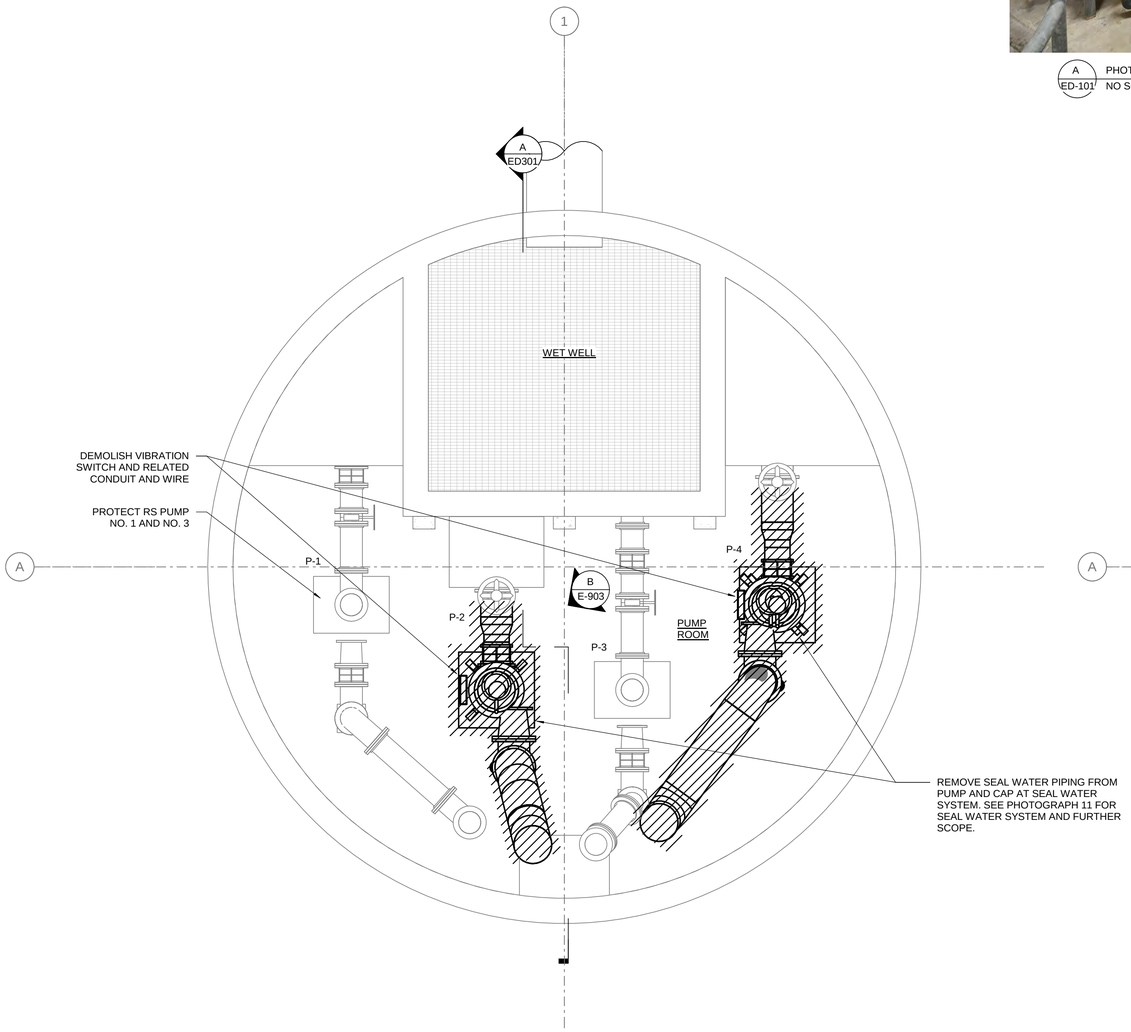
SHEET KEYNOTES

A. REMOVE ABANDONED (OLD T-2) TRANSFORMER (LOCATED SOUTHEAST OF INFLUENT PUMP STATION BETWEEN ODOR CONTROL PIPING). LOW VOLTAGE CABLES ARE ALREADY REMOVED. MEDIUM VOLTAGE CABLES ARE STILL TERMINATED ON THE PRIMARY. REMOVE MEDIUM VOLTAGE CABLES. UNTERMINATE FROM THE UPSTREAM TRANSFORMER T-4 (LOAD BREAK ELBOWS). CABLES ARE UNSPLICED BUT ROUTED THRUGH MANHOLE MH-100 WITH OTHER MEDIUM VOLTAGE CABLES. T-4 TO OLD T-2 DISTANCE IS APPROXIMATELY 120'. THE OWNER REQUESTS THAT WORK BE PERFORMED WITHOUT OUTAGES. ANY OUTAGE REQUESTS SHALL BE COORDINATED PRIOR TO BIDDING. CONTRACTOR SHALL ASSESS THE REQUIREMENTS AT THE PRE-BID WALK THROUGH.

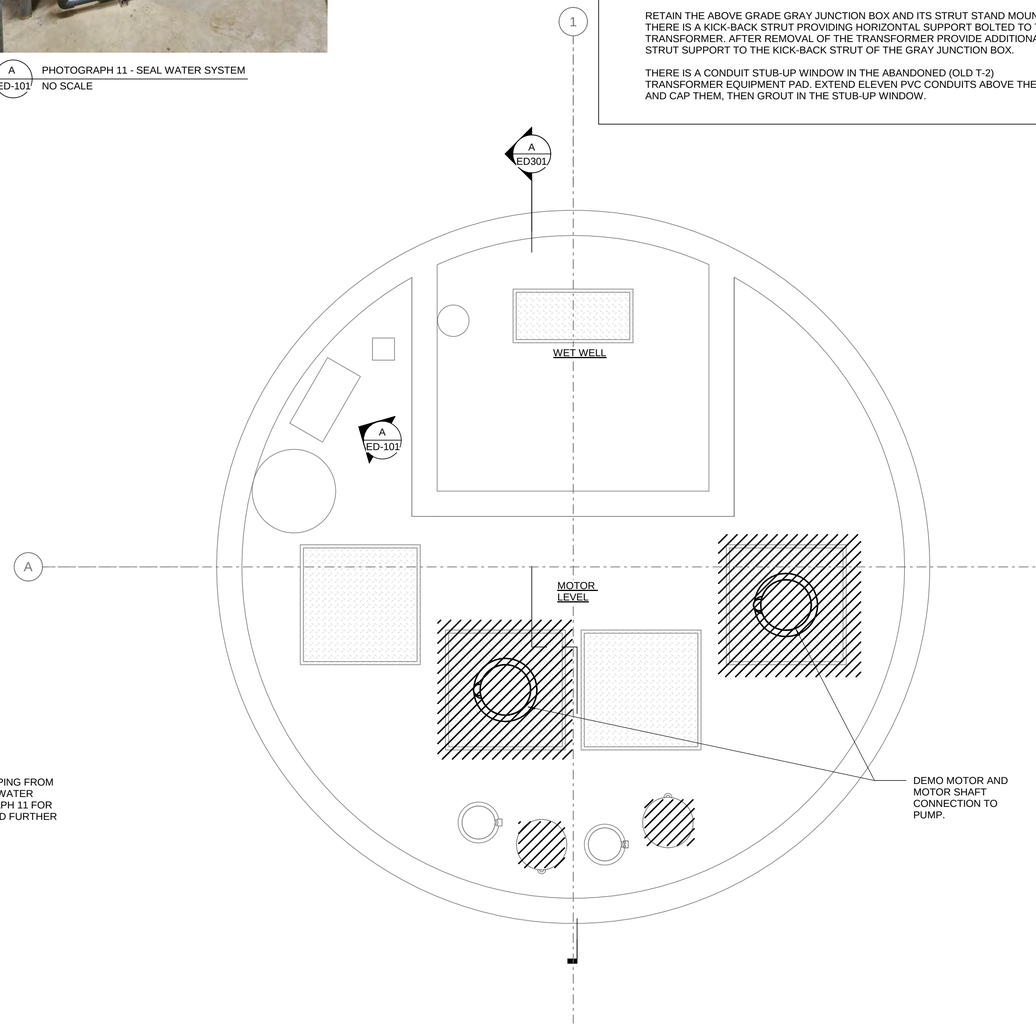
THE CONTRACTOR SHALL RETAIN THE SERVICES OF A CERTIFIED TESTING LAB TO PERFORM POLYCHLORINATED BYPHENYL (PCB) TESTING OF THE TRANSFORMER OIL, AND AT FOUR (4) UNIQUE LOCATIONS WITHIN THE SOIL MATRIX AROUND THE TRANSFORMER TO A DEPTH OF 18". THE CONTRACTOR SHALL PROVIDE TWO BIDS ACCCORDING TO THE BID SCHEDULE: ONE BID ASSUMING PCB'S ARE NOT FOUND WITHIN THE TRANSFORMER AND ONE BID ASSUMING THE TRANSFORMER CONTAINS PCB'S. SHOULD THE SOIL CONTAIN PCB'S, REMOVAL AND DISPOSAL WILL BE NEGOTIATED THROUGH A CHANGE ORDER.

RETAIN THE ABOVE GRADE GRAY JUNCTION BOX AND ITS STRUT STAND MOUNT. THERE IS A KICK-BACK STRUT PROVIDING HORIZONTAL SUPPORT BOLTED TO THE TRANSFORMER. AFTER REMOVAL OF THE TRANSFORMER PROVIDE ADDITIONAL STRUT SUPPORT TO THE KICK-BACK STRUT OF THE GRAY JUNCTION BOX.

THERE IS A CONDUIT STUB-UP WINDOW IN THE ABANDONED (OLD T-2) TRANSFORMER EQUIPMENT PAD. EXTEND ELEVEN PVC CONDUITS ABOVE THE SLAB AND CAP THEM, THEN GROUT IN THE STUB-UP WINDOW.



PLAN AT EL -1.33'
SCALE: 1/4" = 1'-0"



PLAN AT EL 13.75'
SCALE: 1/4" = 1'-0"

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0	FOR CONSTRUCTION	JDP	HS	2021.11.23
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Issued

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER
OREGON
JAN. 12, 1982
JOHN C. DEERKOP

10/19/2021
EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.:2002006172
File Name: N/A
Scale: 1/4" = 1'-0"

BCM	JDP	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

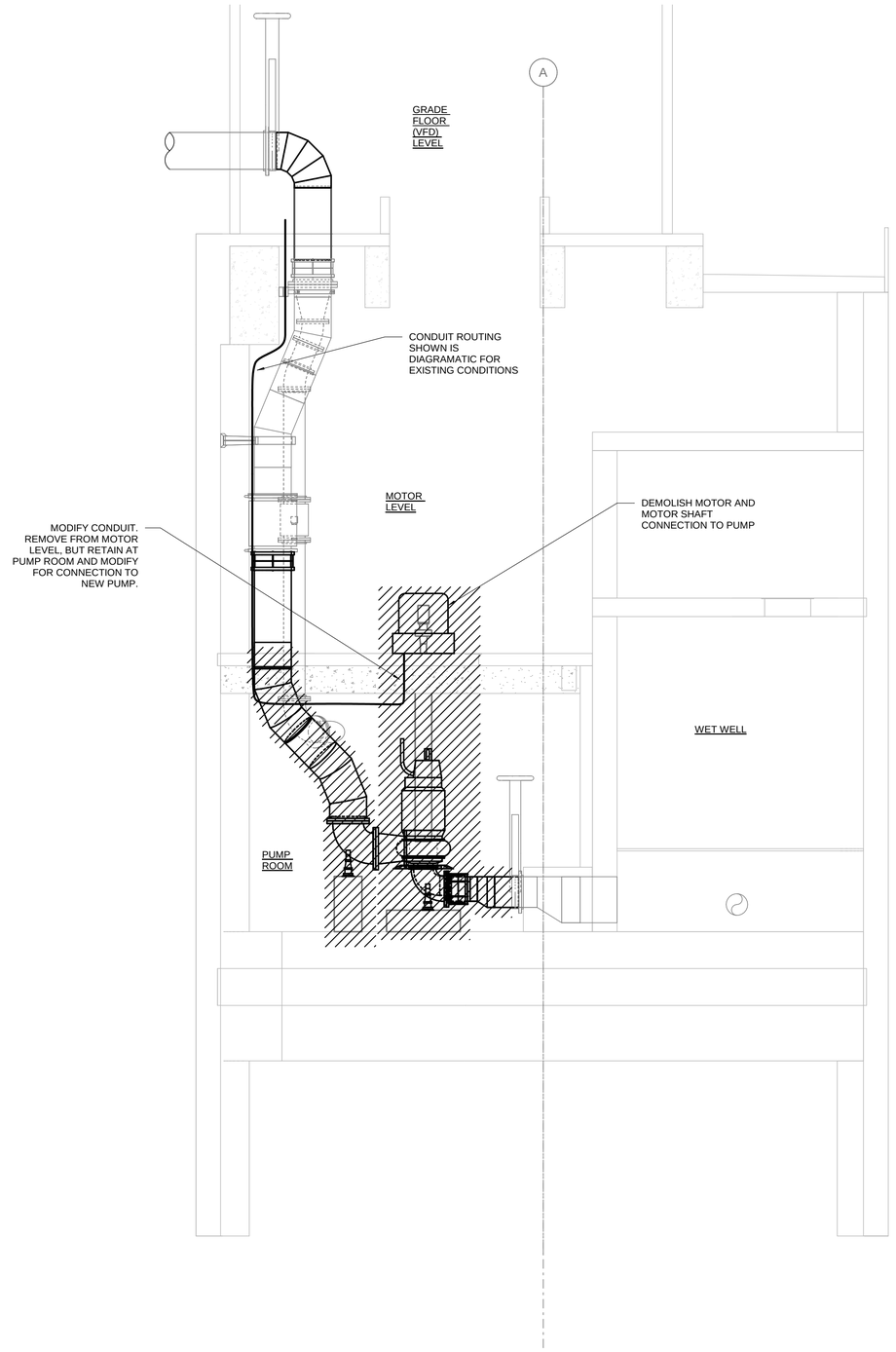
Title
DEMOLITION
PUMP STATION
WET WELL PLANS

Revision:0
Drawing No.
ED101

10/15/21 1:06:24 PM
ORIGINAL SHEET - ANSI D

GENERAL SHEET NOTES

1. NFPA 820 CLASSIFIED AREAS: PER 260000-1.6.A - ALL WORK TO BE PERFORMED UNDER THIS CONTRACT IS IN UNCLASSIFIED AREAS (PUMP ROOM, MOTOR LEVEL, GRADE FLOOR (VFD) LEVEL). THE WET WELL IS A CLASS 1 DIVISION 1 GROUP D AREA, BUT WORK IS NOT REQUIRED IN THE WET WELL UNDER THIS CONTRACT.



A ED101 SECTION
SCALE: 1/4" = 1'-0"

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CLACKAMAS WATER ENVIRONMENT SERVICES

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B 90% PROGRESS PRINTS	JDP	HS	2021.08.11
0 FOR CONSTRUCTION	JDP	HS	2021.11.23

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER
OREGON
JAN. 12, 1999
JOHN C. DEERING

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.:2002006172
File Name: N/A
Scale: 1/4" = 1'-0"

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Title
DEMOLITION
PUMP STATION
WET WELL SECTIONS - I

Revision:0

Drawing No.
ED301

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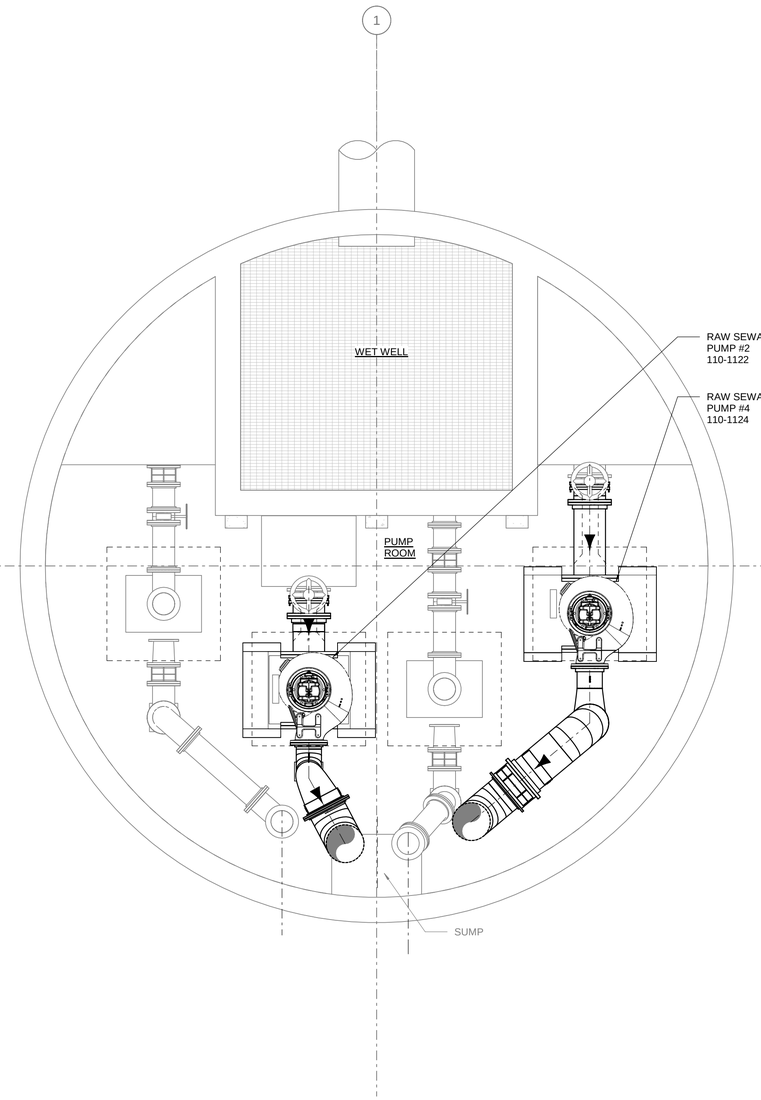
ORIGINAL SHEET - ANSI D

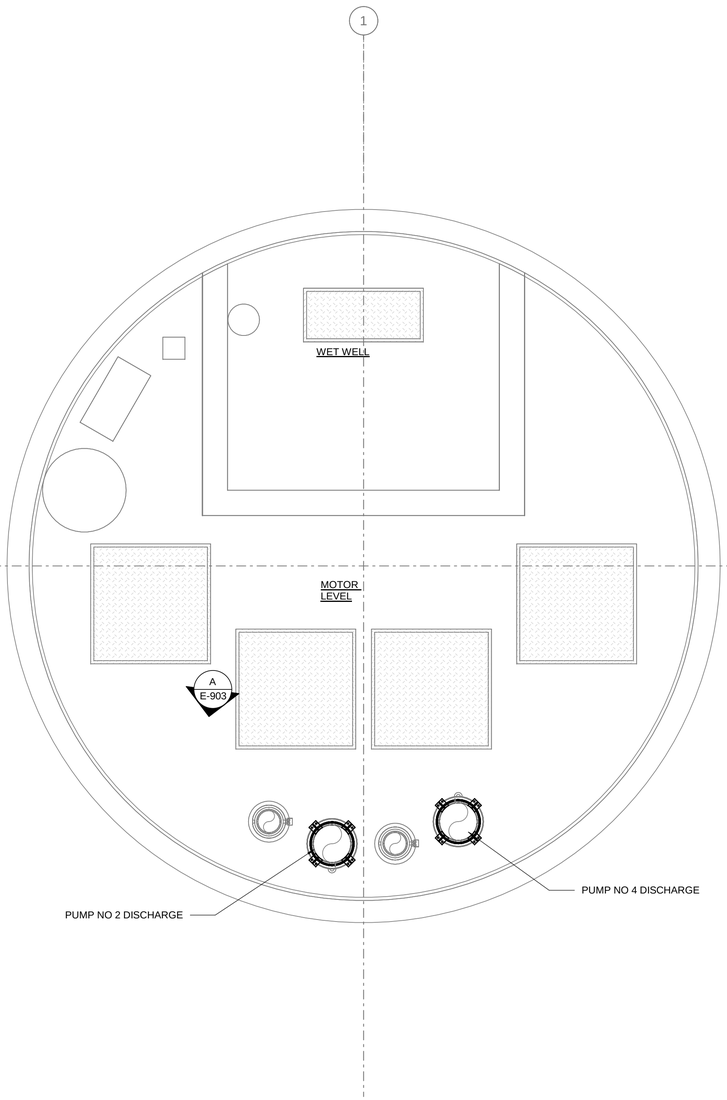
GENERAL SHEET NOTES

1. NFPA 820 CLASSIFIED AREAS: PER 260000-1.6.A - ALL WORK TO BE PERFORMED UNDER THIS CONTRACT IS IN UNCLASSIFIED AREAS (PUMP ROOM, MOTOR LEVEL, GRADE FLOOR (VFD) LEVEL). THE WET WELL IS A CLASS 1 DIVISION 1 GROUP D AREA, BUT WORK IS NOT REQUIRED IN THE WET WELL UNDER THIS CONTRACT.
2. SEE DRAWING E-603 CONDUIT RISER DIAGRAM FOR RACEWAY REQUIREMENTS.



PLAN AT EL -1.33'

SCALE: 1/4" = 1'-0"



PLAN AT EL 13.75'

SCALE: 1/4" = 1'-0"

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CLACKAMAS WATER ENVIRONMENT SERVICES

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B 90% PROGRESS PRINTS	JDP	HS	2021.08.11

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 84440PE JAN. 12, 1988 JOHN C. DEERMOR

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES

KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT

Clackamas County, Oregon

Project No.:2002006172

File Name: N/A

Scale: 1/4" = 1'-0"

BCM	JDP	JCD	2021.11.23
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Title
PUMP STATION
WET WELL PLANS

Revision:0

Drawing No.
E-101

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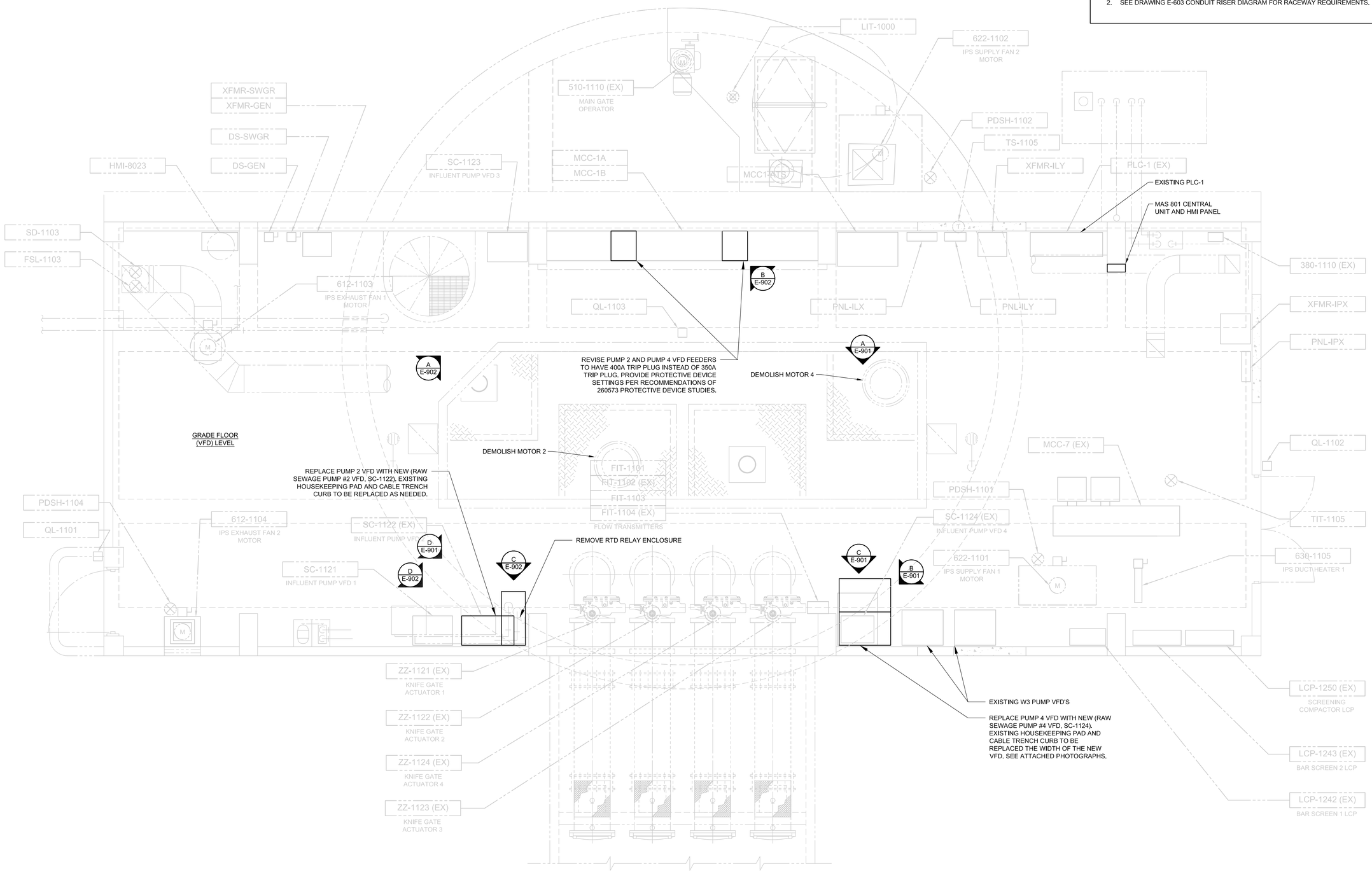
ORIGINAL SHEET - ANSI D

GENERAL SHEET NOTES

1. NFPA 820 CLASSIFIED AREAS: PER 260000-1.6.A- ALL WORK TO BE PERFORMED UNDER THIS CONTRACT IS IN UNCLASSIFIED AREAS (PUMP ROOM, MOTOR LEVEL, GRADE FLOOR (VFD) LEVEL). THE WET WELL IS A CLASS 1 DIVISION 1 GROUP D AREA, BUT WORK IS NOT REQUIRED IN THE WET WELL UNDER THIS CONTRACT.
2. SEE DRAWING E-603 CONDUIT RISER DIAGRAM FOR RACEWAY REQUIREMENTS.



PLAN

SCALE: 3/8"=1'-0"

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CLACKAMAS WATER ENVIRONMENT SERVICES

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A	60% PROGRESS PRINTS	JDP	HS	2021.05.14

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 74440PE OREGON JAN. 12, 1993 JOHN C. DEERWOP

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172E-103

Scale: 3/8" = 1'-0"

Dwn.	Dsgn.	Chkd.	YYYY.MM.DD
MT	JDP	JCD	2021.11.23

Title
INFLUENT PUMP STATION TOP PLAN

Revision:

Drawing No.
E-103

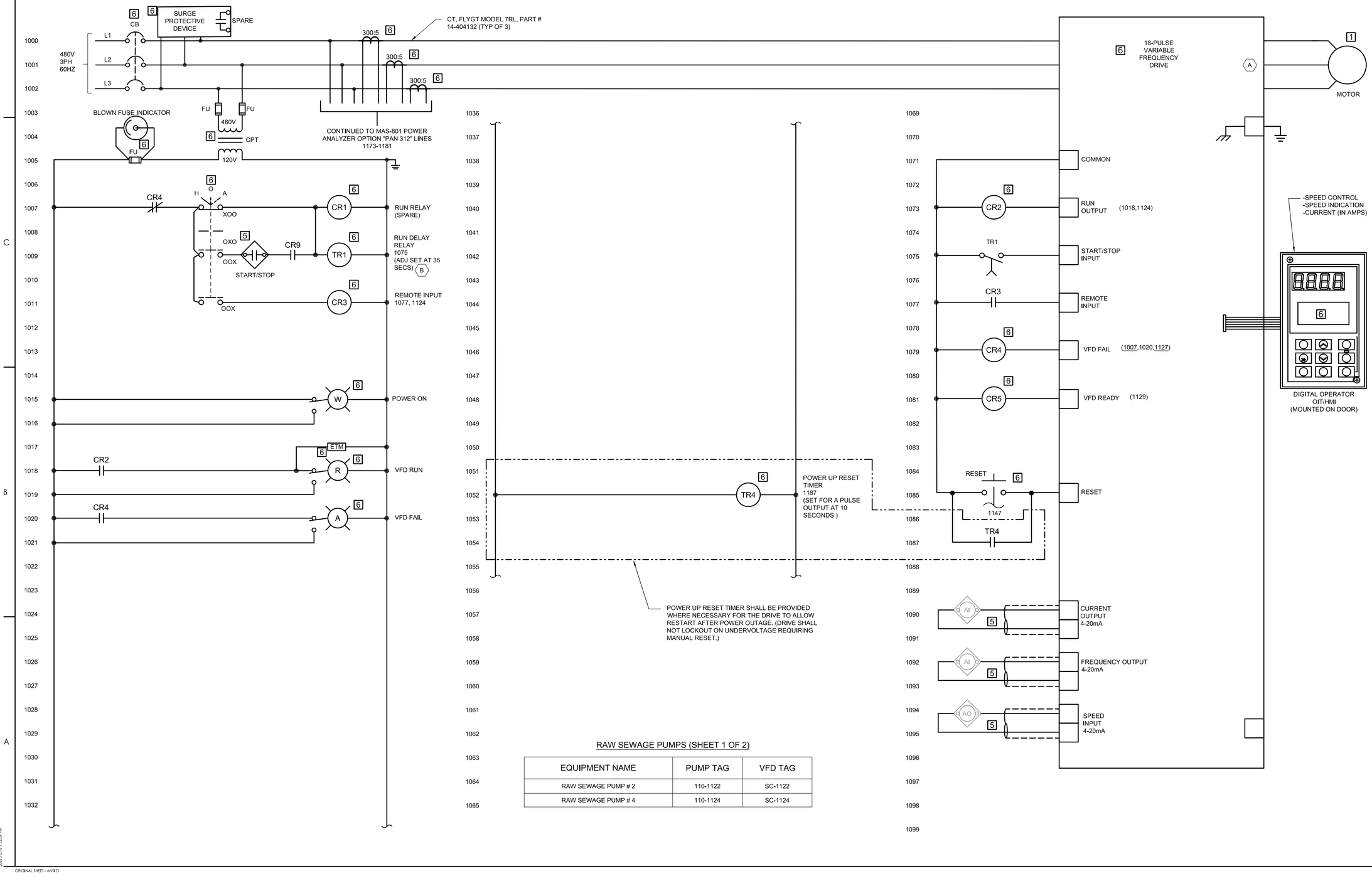
SHEET KEYNOTES

A. DV/DT FILTER SHALL BE PROVIDED IN EACH VFD (NOT SHOWN).

B. 35 SECOND DELAY ACCOUNTS FOR 30 SECOND START-UP DELAY FOR MAS-801

LOCATION LEGEND

1 FIELD
2 NOT USED
3 NOT USED
4 NOT USED
5 PLC
6 VFD



RAW SEWAGE PUMPS (SHEET 1 OF 2)

EQUIPMENT NAME	PUMP TAG	VFD TAG
RAW SEWAGE PUMP # 2	110-1122	SC-1122
RAW SEWAGE PUMP # 4	110-1124	SC-1124

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CLACKAMAS WATER ENVIRONMENT SERVICES

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A	30% PROGRESS PRINTS	JDP	HS	2021.05.14

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 54440PE JAN. 12, 1982 JOHN C. DEERNOR

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172E-601

Scale: NO SCALE

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Title
SCHEMATIC DIAGRAMS - I

Revision:

Drawing No.
E-601

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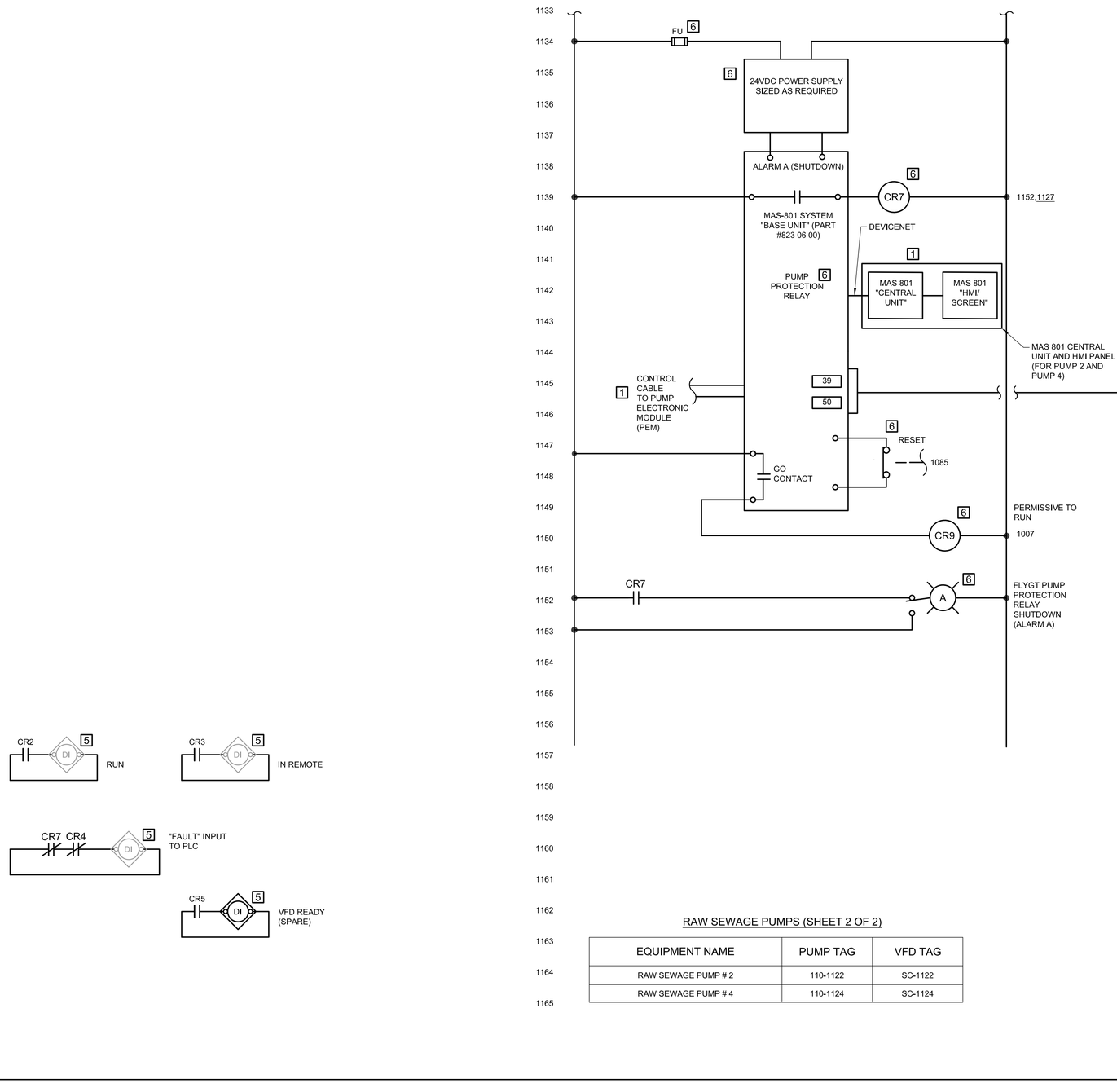
ORIGINAL SHEET - ANSI D

LOCATION LEGEND

1	FIELD
2	NOT USED
3	NOT USED
4	NOT USED
5	PLC
6	VFD



RAW SEWAGE PUMPS (SHEET 2 OF 2)

EQUIPMENT NAME	PUMP TAG	VFD TAG
RAW SEWAGE PUMP # 2	110-1122	SC-1122
RAW SEWAGE PUMP # 4	110-1124	SC-1124

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0	FOR CONSTRUCTION	JDP	HS	2021.11.23

No.	Issued	By	Appd	YYYY.MM.DD
B	90% PROGRESS PRINTS	JDP	HS	2021.09.14
A	30% PROGRESS PRINTS	JDP	HS	2021.05.14

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 54440PE JAN. 12, 1995 JOHN C. DEERHOF

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172E-602

Scale: NO SCALE

MT	JDP	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
SCHEMATIC DIAGRAMS - II

Revision:

Drawing No.
E-602

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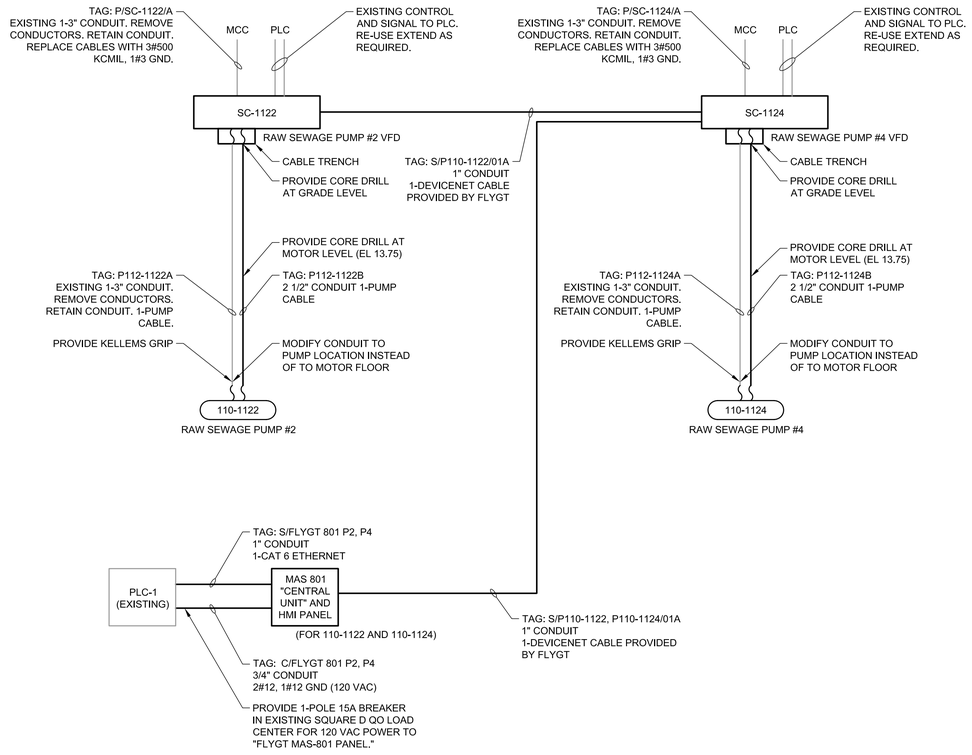
2021.10.13 3:15 PM

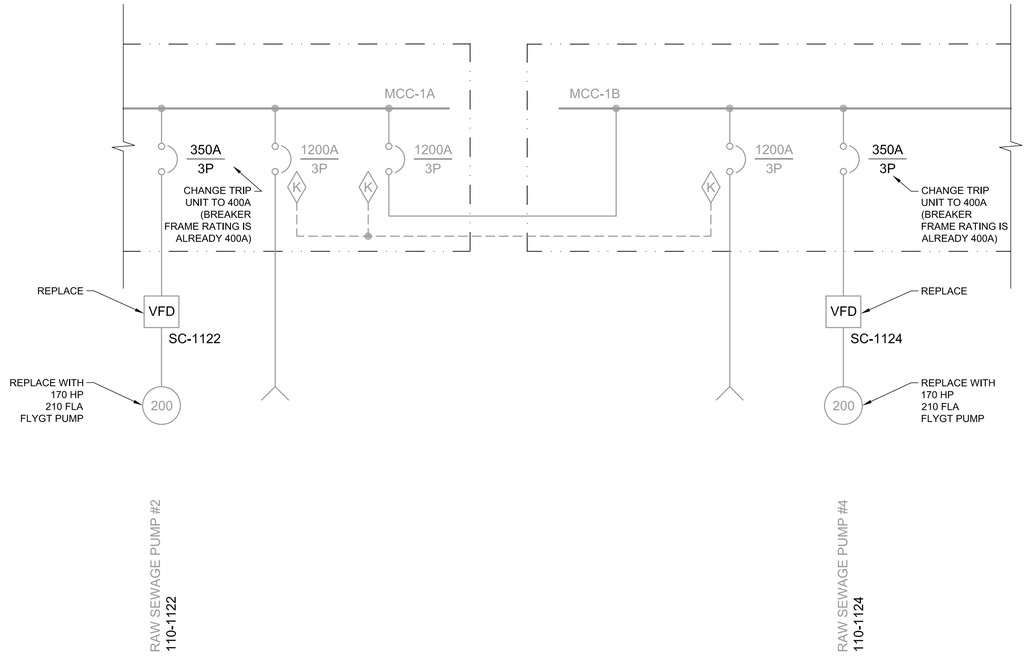
ORIGINAL SHEET - ANSI D

GENERAL SHEET NOTES

1. CONTRACTOR MAY REQUEST RECORD DRAWINGS FROM OWNER FOR PROTECTIVE DEVICE STUDY, AND A COPY OF MOST RECENT PROTECTIVE DEVICE STUDY PERFORMED BY EATON.



CONDUIT RISER DIAGRAM



MCC-1A/1B SINGLE LINE DIAGRAM

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0.	FOR CONSTRUCTION	JDP	HS	2021.11.23

No.	Issued	By	Appd	YYYY.MM.DD
B.	90% PROGRESS PRINTS	JDP	HS	2021.09.14
A.	30% PROGRESS PRINTS	JDP	HS	2021.05.14

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER
OREGON
JAN. 12, 1988
JOHN C. DEERMOND
84440PE

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172E-603

Scale: NO SCALE

MT	JDP	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
SINGLE LINE DIAGRAM AND CONDUIT RISER

Revision:

Drawing No.
E-603

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ORIGINAL SHEET - ANSI D

CONTROL AND SIGNAL CONDUITS FROM VFD TO PLC. RE-USE EXTEND AS REQUIRED.

3" POWER CONDUIT FROM MCC INTO VFD. RETAIN CONDUIT AND REPLACE CABLES WITH 3-500KCML, 1#3 GND.

CONTRACTOR TO VERIFY THAT THIS IS A LINE REACTOR FOR THE EXISTING VFD. IF SO, REMOVE IT. OTHERWISE, IF ITS A PULLBOX IT MAY BE REUSED AT THE CONTRACTOR'S OPTION OR REMOVED AND REPLACED BASED ON APPROVED VFD SHOP DRAWINGS

EXTEND/MODIFY EQUIPMENT PAD AND CABLE TRENCH FOR NEW PUMP 4 VFD. EXISTING VFD IS 30"W X 24"D. PROPOSED VFD IS 48" X 32"D.

PUMP 4 VFD SHALL BE REPLACED. EXISTING VFD IS 30"W X 24"D. PROPOSED VFD IS 48"W X 32"D.

A E-103 PHOTOGRAPH 1 - PUMP 4 VFD

NO SCALE

PUMP 4 VFD SHALL BE REPLACED.

B E-103 PHOTOGRAPH 2 - PUMP 4 VFD

NO SCALE

SHEET KEYNOTES

A.

•CONTRACTOR SHALL MODIFY THE HOUSEKEEPING CURB/PAD FOR THE NEW VFD. EXISTING VFD IS 30"WX24"D. NEW VFD IS PROPOSED 48"WX32"D. PROVIDE HOUSEKEEPING CURB/PAD MODIFICATIONS AND ANCHORING OF VFD TO CURB/PAD. PROVIDE PE STAMPED ANCHORAGE CALCULATION FOR VFD APPROVED DURING SHOP DRAWING REVIEW. ASSUME THE VFD HOUSEKEEPING CURB/PAD SHALL BE REPLACED IN FULL FOR PURPOSES OF BIDDING.

•THE VFD CABLE TRENCH CONCEPT SHALL BE MAINTAINED. MODIFY THE VFD CABLE TRENCH AS REQUIRED (INCLUDE YELLOW PAINT FOR NEW CURB AND NEW STAINLESS STEEL TRENCH COVER). ASSUME THE EXISTING CABLE TRENCH CURB SHALL BE REPLACED IN FULL FOR PURPOSES OF BIDDING. THERE IS ONE SET OF POWER CABLES PER VFD IN THE CABLE TRENCH. PROVIDE A SECOND CORE DRILL FOR THE SECOND SET OF POWER CABLES REQUIRED PER PUMP (FOR 2-1/2" MINIMUM CONDUIT). THE CABLE TRENCH CURB LIMIT SHALL NOT BE FURTHER EAST THAN ITS EXISTING CONDITION TO MAINTAIN AISLE SPACE.

•FOR THE PUMP 2 VFD: THE EXISTING CABLE TRENCH EXTENDS UNDER THE PUMP 2 VFD, THE PUMP 1 VFD AND INCLUDES BUBBLER PIPING. THE PUMP 2 VFD HOUSEKEEPING CURB/PAD WILL EXTEND (SOUTH) INTO THE EXISTING CABLE TROUGH/TRENCH. THE BUBBLER PIPING MAY BE ENCASED IN THE NEW PAD. THE PUMP 1 VFD CABLES MUST BE UNTERMINATED AND PULLED BACK, PROVIDE RGS CONDUIT SLEEVE/S WITHIN THE NEW CURB AND THEN REPULL AND RETERMINATE THE PUMP 1 VFD CABLES.

MOTOR RTD CABLES FROM THE MOTOR TO THE EXISTING RTD RELAY IN THE PUMP 4 VFD. CONFIRM AND DEMOLISH. REMOVE CONDUIT AND CABLE TO MOTOR.

A

VFD OUTPUT POWER CABLES AND GROUND CABLE TO MOTOR. REMOVE AND REPLACE WITH NEW PUMP CABLES. PROVIDE ONE ADDITIONAL CORE DRILL TO ACCOMMODATE THE SECOND SET OF PUMP POWER CABLES.

C E-103 PHOTOGRAPH 3 - PUMP 4 VFD CABLE TRENCH

NO SCALE

PUMP 2 VFD SHALL BE DEMOLISHED AND REPLACED. SCOPE IS SIMILAR TO PUMP 4 VFD. SEE PHOTOGRAPH 1, 2, AND 3 ON THIS SHEET FOR TYPICAL MODIFICATIONS REQUIRED FOR THE PUMP 2 VFD (AS SHOWN FOR PUMP 4 VFD).

REMOVE TWO RTD RELAYS AND ENCLOSURE AND TURN OVER TO OWNER. ONE RTD RELAY IS FOR PUMP 2 RTD'S (WHICH SHALL BE REMOVED WHEN ITS PUMP/MOTOR ARE REPLACED UNDER THIS CONTRACT). THE OTHER RTD RELAY IS ABANDONED. DEMOLISH CONDUIT AND CABLE TO/FROM MOTOR RTD'S AND TO/FROM VFD.

D E-103 PHOTOGRAPH 4 - RTD RELAY AND PUMP 2 VFD

NO SCALE

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0.	FOR CONSTRUCTION	JDP	HS	2021.11.23
A.	90% PROGRESS PRINTS	JDP	HS	2021.08.11
B.	30% PROGRESS PRINTS	JDP	HS	2021.05.14

Issued

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 14440PE OREGON JAN. 12, 1982 JOHN C. DEERMOR

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172

File Name: 06172E-901

Scale: NO SCALE

MT	JDP	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
PHOTOGRAPHS - I

Revision:

Drawing No.
E-901

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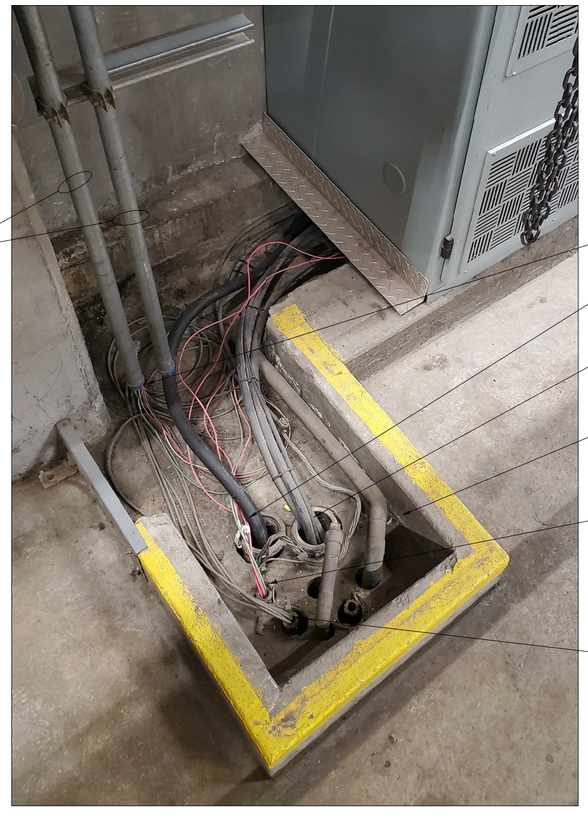
ORIGINAL SHEET - ANSI D

AT MCC, REPLACE PUMP 2 AND PUMP 4 VFD EATON HKD 350A TRIP PLUG WITH 400A TRIP PLUG.
REVISE SETTINGS PER RECOMMENDATIONS OF 260573 PROTECTIVE DEVICE STUDIES.

A PHOTOGRAPH 5 - MCC-1A/1B MODIFICATIONS
A / E-103
NO SCALE



REMOVE RTD CONDUITS

PUMP 2 RTD CABLES, AND PUMP 2 HIGH TEMP TO PUMP 2 VFD (REMOVE)

PUMP 1 CABLE (PROTECT. PROVIDE RGS CONDUIT IN CABLE TRENCH FOR PASSING BENEATH PUMP 2 VFD)

PUMP 2 POWER CABLES (REMOVE & REPLACE). ADD NEW CORE DRILL FOR SECOND PUMP POWER CABLE.

BUBBLER PIPING (PROTECT)

CONTRACTOR SHALL CONFIRM. WIRES FOR PUMP 1 MINICAS SHALL BE PROTECTED (PROVIDE RGS CONDUIT IN CABLE TRENCH FOR PASSING BENEATH PUMP 2 VFD). ADDITIONAL WIRES SHALL BE IDENTIFIED BY CONTRACTOR AND EITHER PROTECTED OR REMOVED ACCORDINGLY.

PUMP 2 RTD CABLES (REMOVE). ALSO REMOVE RTD CONDUIT TO EXISTING MOTOR LOCATION.

B PHOTOGRAPH 6 - MCC-1A/1B MODIFICATIONS
B / E-103
NO SCALE

PUMP 1 AND 2 RTD RELAY ENCLOSURE (REMOVE)

PUMP 2 VFD (REMOVE)

SEE PHOTO 7

PUMP 1 VFD (PROTECT)

PUMP 1 POWER AND CONTROL CABLES (PROTECT)

BUBBLER PIPING (PROTECT)

C PHOTOGRAPH 7 - PUMP 1 AND 2 VFD CABLE TRENCH
C / E-103 A
NO SCALE

D PHOTOGRAPH 8 - PUMP 1 AND 2 VFD CABLE TRENCH
D / E-103 A
NO SCALE

SHEET KEYNOTES

A.

•CONTRACTOR SHALL MODIFY THE HOUSEKEEPING CURB/PAD FOR THE NEW VFD. EXISTING VFD IS 30"WX24"D. NEW VFD IS PROPOSED 48"WX32"D. PROVIDE HOUSEKEEPING CURB/PAD MODIFICATIONS AND ANCHORING OF VFD TO CURB/PAD. PROVIDE PE STAMPED ANCHORAGE CALCULATION FOR VFD APPROVED DURING SHOP DRAWING REVIEW. ASSUME THE VFD HOUSEKEEPING CURB/PAD SHALL BE REPLACED IN FULL FOR PURPOSES OF BIDDING.

•THE VFD CABLE TRENCH CONCEPT SHALL BE MAINTAINED. MODIFY THE VFD CABLE TRENCH AS REQUIRED (INCLUDE YELLOW PAINT FOR NEW CURB AND NEW STAINLESS STEEL TRENCH COVER). ASSUME THE EXISTING CABLE TRENCH CURB SHALL BE REPLACED IN FULL FOR PURPOSES OF BIDDING. THERE IS ONE SET OF POWER CABLES PER VFD IN THE CABLE TRENCH. PROVIDE A SECOND CORE DRILL FOR THE SECOND SET OF POWER CABLES REQUIRED PER PUMP (FOR 2-1/2" MINIMUM CONDUIT). THE CABLE TRENCH CURB LIMIT SHALL NOT BE FURTHER EAST THAN ITS EXISTING CONDITION TO MAINTAIN AISLE SPACE.

•FOR THE PUMP 2 VFD: THE EXISTING CABLE TRENCH EXTENDS UNDER THE PUMP 2 VFD, THE PUMP 1 VFD AND INCLUDES BUBBLER PIPING. THE PUMP 2 VFD HOUSEKEEPING CURB/PAD WILL EXTEND (SOUTH) INTO THE EXISTING CABLE TROUGH/TRENCH. THE BUBBLER PIPING MAY BE ENCASED IN THE NEW PAD. THE PUMP 1 VFD CABLES MUST BE UNTERMINATED AND PULLED BACK, PROVIDE RGS CONDUIT SLEEVE/S WITHIN THE NEW CURB AND THEN REPULL AND RETERMINATE THE PUMP 1 VFD CABLES.

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0	FOR CONSTRUCTION	JDP	HS	2021.11.23
B	90% PROGRESS PRINTS	JDP	HS	2021.05.14
A	60% PROGRESS PRINTS	JDP	HS	2021.03.31

Issued

Permit/Seal

REGISTERED PROFESSIONAL ENGINEER 54440PE JAN. 12, 1995 JOHN C. DEERHOF

10/19/2021

EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172
File Name: 06172E-902
Scale: NO SCALE

MT	JDP	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
PHOTOGRAPHS - II

Revision:
Drawing No.
E-902

ORIGINAL SHEET - ANSI D

EXISTING PUMP POWER AND RTD CABLES ARE BEHIND A NOTCH OUT IN THE HVAC DUCTWORK (PUMP 1 AND PUMP 2 SHOWN). A SECOND POWER CONDUIT IS REQUIRED FOR PUMP 2 AND 4 (TO BE PROVIDED UNDER THIS CONTRACT). THE CONDUIT FOR PUMP 2 SHALL BE ROUTED THROUGH A NOTCH OUT IN THE HVAC DUCTWORK SIMILAR TO EXISTING CONDITIONS.

AS PART OF THIS CONTRACT ADD A THIRD LARGE CONDUIT NEXT TO THE EXISTING TWO LARGE CONDUITS. THE THIRD CONDUIT SHALL BE AGAINST THE WALL. MODIFY THE DUCTWORK IN-KIND FOR THE LARGER OPENING REQUIRED. REMOVE THE SECTION OF DUCTWORK, PROVIDE MODIFICATIONS, REPAIR ANY CORROSION, REPAINT, AND REINSTALL. UTILIZE A QUALIFIED HVAC SUBCONTRACTOR TO PERFORM THE WORK. PROVIDE ADDITIONAL TEMPORARY SUPPORT AS REQUIRED FOR THE REMAINDER OF DUCTWORK WHILE THIS SECTION IS REMOVED. PROVIDE SUPPLEMENTAL VENTILATION DURING THE HVAC DUCTWORK MODIFICATION.

NOTE THAT PUMP 4 CONDUIT AVOIDS THE DUCTWORK AND WILL NOT REQUIRE A SIMILAR MODIFICATION.

A E-101 PHOTOGRAPH 9 - EXISTING PUMP CONDUIT (MOTOR LEVEL)
NO SCALE

REMOVE MOTOR SHAFT AND MOTOR (ABOVE)

MODIFY CONDUIT. REMOVE FROM MOTOR LEVEL, BUT RETAIN AT PUMP ROOM AND MODIFY FOR CONNECTION TO NEW DRY PIT SUBMERSIBLE PUMP.

DEMOLISH VIBRATION SWITCH AND RELATED CONDUIT AND WIRE.

B ED-101 PHOTOGRAPH 10 - EXISTING PUMP
NO SCALE

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CLACKAMAS WATER ENVIRONMENT SERVICES

No.	Revision	By	Appd	YYYY.MM.DD
0	FOR CONSTRUCTION	JDP	HS	2021.11.23

Issued	By	Appd	YYYY.MM.DD
A 30% PROGRESS PRINTS	JDP	HS	2021.08.11
B 90% PROGRESS PRINTS	JDP	HS	2021.10.14

Permit/Seal
REGISTERED PROFESSIONAL ENGINEER 13444PE JAN. 12, 1999 JOHN C. DEERING
10/19/2021
EXPIRES: 12/31/21

Client/Project
CLACKAMAS WATER ENVIRONMENT SERVICES
KELLOGG CREEK WATER RESOURCE RECOVERY FACILITY INFLUENT PUMP 2 AND 4 REPLACEMENT
Clackamas County, Oregon

Project No.: 2002006172
File Name: 06172E-903
Scale: NO SCALE

MT	JDP	JCD	2021.11.23
Dwn.	Dsgn.	Chkd.	YYYY.MM.DD

Title
PHOTOGRAPHS - III

Revision:
Drawing No.
E-903

EXHIBIT E

Bonds

CLACKAMAS WATER ENVIRONMENT SERVICES

WATER ENVIRONMENT SERVICES
PUBLIC IMPROVEMENT CONTRACT

PERFORMANCE BOND

Bond No.: 109 43 34
Solicitation: 2021-87
Project Name: Kellogg Creek Water Resource Recovery Facility Influent Pump 2 and 4 Replacement

The Hanover Insurance Company (Surety #1)	Bond Amount No. 1:	$ 1,466,125.00
_____ (Surety #2)*	Bond Amount No. 2:*	$ _____
* *If using multiple sureties*	Total Penal Sum of Bond:	$ 1,466,125.00

We, R.L. Reimers Co. as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors and assigns firmly by these presents to pay unto Water Environment Services ("District"), the sum of (Total Penal Sum of Bond) $ One million four hundred sixty-six thousand one hunred twenty-five dollars (Provided, that we the Sureties bind ourselves in such sum "jointly and severally" as well as "severally" only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety); and

WHEREAS, the Principal has entered into a contract with the District, along with the plans, specifications, terms and conditions of which are contained in the above-referenced Project Contract Documents; and

WHEREAS, the terms and conditions of the contract, together with applicable plans, standard specifications, special provisions, schedule of performance, and schedule of contract prices, are made a part of this Performance Bond by reference, whether or not attached to the contract (all hereafter called "Contract"); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans and specifications, and all authorized modifications of the Contract which increase the amount of the work, the amount of the Contract, or constitute an authorized extension of the time for performance, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal herein shall faithfully and truly observe and comply with the terms, conditions and provisions of the Contract, in all respects, and shall well and truly and fully do and perform all matters and things undertaken by Contractor to be performed under the Contract, upon the terms set forth therein, and within the time prescribed therein, or as extended as provided in the Contract, with or without notice to the Sureties, and shall defend, indemnify, and save harmless the District and Clackamas County and their elected officials, officers, employees and agents, against any direct or indirect damages or claim of every kind and description that shall be suffered or claimed to be suffered in connection with or arising out of the performance of the Contract by the Principal or its subcontractors, and shall in all respects perform said contract according to law, then this obligation is to be void; otherwise, it shall remain in full force and effect for so long as any term of the Contract remains in effect.

Nonpayment of the bond premium will not invalidate this bond nor shall the District, be obligated for the payment of any premiums.

This bond is given and received under authority of Oregon Revised Statutes Chapter 279C and the Clackamas County Local Contractor Review Board Rules, the provisions of which hereby are incorporated into this bond and made a part hereof.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES.

Dated this 10th day of March, 20 22.

PRINCIPAL: R.L. Reimers Co.

By: _____
Ron Reimers — Signature
President — Official Capacity

Attest: _____
Corporation Secretary

SURETY: The Hanover Insurance Company
[Add signatures for each if using multiple bonds]

BY ATTORNEY-IN-FACT:
[Power-of-Attorney must accompany each bond]

Todd Brem — Name

_____ — Signature

13810 SW 31st Ct. — Address

Beaverton, — OR 97008
City — State Zip

503-671-9172 — 503-671-9172
Phone — Fax

CLACKAMAS WATER ENVIRONMENT SERVICES

WATER ENVIRONMENT SERVICES
PUBLIC IMPROVEMENT CONTRACT

PAYMENT BOND

Bond No.: 109 43 34
Solicitation: #2021-87
Project Name: Kellogg Creek Water Resource Recovery Facility Influent Pump 2 and 4 Replacement

The Hanover Insurance Company (Surety #1)	Bond Amount No. 1:	$ 1,466,125.00
_____ (Surety #2)*	Bond Amount No. 2:*	$ _____
* *If using multiple sureties*	Total Penal Sum of Bond:	$ 1,466,125.00

We, R.L. Reimers Co., as Principal, and the above identified Surety(ies), authorized to transact surety business in Oregon, as Surety, hereby jointly and severally bind ourselves, our respective heirs, executors, administrators, successors and assigns firmly by these presents to pay unto Water Environment Services ("District"), the sum of (Total Penal Sum of Bond) One million four hundred sixty-six thousand one hundred twenty-five dollars (Provided, that we the Sureties bind ourselves in such sum "jointly and severally" as well as "severally" only for the purpose of allowing a joint action or actions against any or all of us, and for all other purposes each Surety binds itself, jointly and severally with the Principal, for the payment of such sum only as is set forth opposite the name of such Surety); and

WHEREAS, the Principal has entered into a contract with the District, along with the plans, specifications, terms and conditions of which are contained in above-referenced Project Contract Documents; and

WHEREAS, the terms and conditions of the contract, together with applicable plans, standard specifications, special provisions, schedule of performance, and schedule of contract prices, are made a part of this Payment Bond by reference, whether or not attached to the contract (all hereafter called "Contract"); and

WHEREAS, the Principal has agreed to perform the Contract in accordance with the terms, conditions, requirements, plans and specifications, and schedule of contract prices which are set forth in the Contract and any attachments, and all authorized modifications of the Contract which increase the amount of the work, or the cost of the Contract, or constitute authorized extensions of time for performance of the Contract, notice of any such modifications hereby being waived by the Surety:

NOW, THEREFORE, THE CONDITION OF THIS BOND IS SUCH that if the Principal shall faithfully and truly observe and comply with the terms, conditions and provisions of the Contract, in all respects, and shall well and truly and fully do and perform all matters and things by it undertaken to be performed under said Contract and any duly authorized modifications that are made, upon the terms set forth therein, and within the time prescribed therein, or as extended therein as provided in the Contract, with or without notice to the Sureties, and shall defend, indemnify, and save harmless the District and Clackamas County and their elected officials, officers, employees and agents, against any claim for direct or indirect damages of every kind and description that shall be suffered or claimed to be suffered in connection with or arising out of the performance of the Contract by the Contractor or its subcontractors, and shall promptly pay all persons supplying labor, materials or both to the Principal or its subcontractors for prosecution of the work provided in the Contract; and shall promptly pay all contributions due the State Industrial Accident Fund and the State Unemployment Compensation Fund from the Principal or its subcontractors in connection with the performance of the Contract; and shall pay over to the Oregon Department of Revenue all sums required to be deducted and retained from the wages of employees of the Principal and its subcontractors pursuant to ORS 316.167, and shall permit no lien nor claim to be filed or prosecuted against the District on account of any labor or materials furnished; and shall do all things required of

the Principal by the laws of this State, then this obligation shall be void; otherwise, it shall remain in full force and effect for so long as any term of the Contract remains in effect.
Nonpayment of the bond premium will not invalidate this bond nor shall the District be obligated for the payment of any premiums.

This bond is given and received under authority of Oregon Revised Statutes Chapter 279C and the Clackamas County Local Contractor Review Board Rules, the provisions of which hereby are incorporated into this bond and made a part hereof.

IN WITNESS WHEREOF, WE HAVE CAUSED THIS INSTRUMENT TO BE EXECUTED AND SEALED BY OUR DULY AUTHORIZED LEGAL REPRESENTATIVES:

Dated this 10th day of March, 20 22.

PRINCIPAL: R.L. Reimers Co.

By: _____
Ron Reimers — Signature
President — Official Capacity

Attest: _____
Corporation Secretary

SURETY: The Hanover Insurance Company
[Add signatures for each if using multiple bonds]

BY ATTORNEY-IN-FACT:
[Power-of-Attorney must accompany each bond]

Todd Brem
Name

Signature

13810 SW 31st Ct.
Address

Beaverton OR 97008
City State Zip

503-671-9172 503-671-9172
Phone Fax

THE HANOVER INSURANCE COMPANY INCORPORATED 1972 NEW HAMPSHIRE

THE HANOVER INSURANCE COMPANY
MASSACHUSETTS BAY INSURANCE COMPANY
CITIZENS INSURANCE COMPANY OF AMERICA

POWERS OF ATTORNEY
CERTIFIED COPY

KNOW ALL MEN BY THESE PRESENTS: That THE HANOVER INSURANCE COMPANY and MASSACHUSETTS BAY INSURANCE COMPANY, both being corporations organized and existing under the laws of the State of New Hampshire, and CITIZENS INSURANCE COMPANY OF AMERICA, a corporation organized and existing under the laws of the State of Michigan, do hereby constitute and appoint

Todd Brem and/or Carol Brem

of **Beaverton, OR** and each is a true and lawful Attorney(s)-in-fact to sign, execute, seal, acknowledge and deliver for, and on its behalf, and as its act and deed any place within the United States, or, if the following line be filled in, only within the area therein designated any and all bonds, recognizances, undertakings, contracts of indemnity or other writings obligatory in the nature thereof, as follows:

Any such obligations in the United States, not to exceed Thirty Million and No/100 ($30,000,000) in any single instance

and said companies hereby ratify and confirm all and whatsoever said Attorney(s)-in-fact may lawfully do in the premises by virtue of these presents. These appointments are made under and by authority of the following Resolution passed by the Board of Directors of said Companies which resolutions are still in effect:

"RESOLVED, That the President or any Vice President, in conjunction with any Vice President, be and they are hereby authorized and empowered to appoint Attorneys-in-fact of the Company, in its name and as its acts, to execute and acknowledge for and on its behalf as Surety any and all bonds, recognizances, contracts of indemnity, waivers of citation and all other writings obligatory in the nature thereof, with power to attach thereto the seal of the Company. Any such writings so executed by such Attorneys-in-fact shall be as binding upon the Company as if they had been duly executed and acknowledged by the regularly elected officers of the Company in their own proper persons." (Adopted October 7, 1981 - The Hanover Insurance Company; Adopted April 14, 1982 - Massachusetts Bay Insurance Company; Adopted September 7, 2001 - Citizens Insurance Company of America)

IN WITNESS WHEREOF, THE HANOVER INSURANCE COMPANY, MASSACHUSETTS BAY INSURANCE COMPANY and CITIZENS INSURANCE COMPANY OF AMERICA have caused these presents to be sealed with their respective corporate seals, duly attested by two Vice Presidents, this **6th** day of **September 2013**.

THE HANOVER INSURANCE COMPANY
MASSACHUSETTS BAY INSURANCE COMPANY
CITIZENS INSURANCE COMPANY OF AMERICA

Robert Thomas, Vice President

Joe Brenstrom, Vice President

THE COMMONWEALTH OF MASSACHUSETTS)
COUNTY OF WORCESTER) ss.

On this **6th** day of **September 2013** before me came the above named Vice Presidents of The Hanover Insurance Company, Massachusetts Bay Insurance Company and Citizens Insurance Company of America, to me personally known to be the individuals and officers described herein, and acknowledged that the seals affixed to the preceding instrument are the corporate seals of The Hanover Insurance Company, Massachusetts Bay Insurance Company and Citizens Insurance Company of America, respectively, and that the said corporate seals and their signatures as officers were duly affixed and subscribed to said instrument by the authority and direction of said Corporations.

BARBARA A. GARLICK
Notary Public
Commonwealth of Massachusetts
My Commission Expires Sept. 21, 2018

Barbara A. Garlick, Notary Public
My Commission Expires September 21, 2018

I, the undersigned Vice President of The Hanover Insurance Company, Massachusetts Bay Insurance Company and Citizens Insurance Company of America, hereby certify that the above and foregoing is a full, true and correct copy of the Original Power of Attorney issued by said Companies, and do hereby further certify that the said Powers of Attorney are still in force and effect.

This Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of The Hanover Insurance Company, Massachusetts Bay Insurance Company and Citizens Insurance Company of America.

"RESOLVED, That any and all Powers of Attorney and Certified Copies of such Powers of Attorney and certification in respect thereto, granted and executed by the President or any Vice President in conjunction with any Vice President of the Company, shall be binding on the Company to the same extent as if all signatures therein were manually affixed, even though one or more of any such signatures thereon may be facsimile." (Adopted October 7, 1981 - The Hanover Insurance Company; Adopted April 14, 1982 - Massachusetts Bay Insurance Company; Adopted September 7, 2001 - Citizens Insurance Company of America)

GIVEN under my hand and the seals of said Companies, at Worcester, Massachusetts, this 10th day of March 2022.

THE HANOVER INSURANCE COMPANY
MASSACHUSETTS BAY INSURANCE COMPANY
CITIZENS INSURANCE COMPANY OF AMERICA

J. Michael Pete, Vice President