SECTION 01 14 00

WORK RESTRICTIONS

PART 1 GENERAL

1.1 DESCRIPTION

This project involves modifications to an existing wastewater lift station. Wastewater flows continuously to the lift station, which then pumps the wastewater to another location. Wastewater flow to the station varies throughout the day, but it cannot be stopped without risking an overflow event that requires public notification and may result in fines from the Washington State Department of Ecology.

1.2 CONSTRUCTION SEQUENCE REQUIREMENTS

In order to maintain reliable wastewater service, the work must be completed in the following sequence:

A. Install and prove successful operation of temporary bypass pumping system.

B. System Integration and Programming

1. All work associated with instrumentation and controls, including removal, demolition, interruption and installation of instruments, controls, and other components associated with the City's SCADA system shall be closely coordinated with the Owner.

2. Start-up, testing and commissioning of the 44th Street & 67th Avenue Lift Station will require system integration and programming to properly operate, control and monitor facility system.

3. Contractor shall coordinate work and scheduling with system integration and programming needs, which is being provided by the City's system integrator, S&B Inc.

4. Contractor shall work with the City's system integrator, S&B Inc., to define scheduling, access and timelines to allow programming of equipment after it is properly installed.

1.3 CONSTRAINTS

A. The existing wastewater pumping capacity at the 44th Street & 67th Avenue Lift Station must be maintained by the lift station or by temporary bypass pumping throughout the duration of this project.

B. Construction activities that disrupt electrical service or lift station operation shall not be initiated except as set forth herein.

C. Contractor is responsible to plan, schedule, and sequence all construction activities to ensure that wastewater service is maintained at all times, subject to the exceptions identified herein.

D. Contractor shall give proper attention to each of the following items so as to minimize interruptions of the wastewater utility service. Constraints listed below involve limits on activities during construction.

1. Stage work to maintain access to site facilities at all times for the Owner.

2. Coordinate construction schedule and operation with Owner.

3. Coordinate proposed work with Owner and Engineer and facility operations personnel before implementing facility shutdowns as defined herein.

4. The transition from a shutdown condition back to normal operations shall be conducted no later than two hours prior to the end of a normal working day. Under no circumstances shall work cease at the end of a normal working day if such action may inadvertently cause an interruption of any facility operation; in which case, remain on site until necessary repairs are complete.

5. No interruptions to normal operations will be scheduled on a Friday.

6. Power supply, SCADA communications, and security shall be maintained except during planned outages with advance approval by the Owner.

7. Do not operate valves, disconnect power, disconnect telephone or take other action that would affect the operation of existing systems, except as specifically required by the Contract Documents and after approval of Engineer.

8. The Contractor shall not operate any of the existing equipment except when specifically directed to do so by the Engineer.

E. Noise Limitations - The project area is located within a residential zone. Comply with applicable City Noise Ordinance and State and Federal regulations.

F. Street Cleanup – The Contractor shall clean daily all dirt, gravel, construction debris and other foreign material resulting from its operations from all streets and roads.

G. Work Within Private Easements – When portions of the work contemplated are within easements held by the Owner on private property, the Contractor shall ascertain for itself to what extent the width, status and special conditions attached to easements may have on its operations and all costs resulting therefrom shall be included and

absorbed in the unit prices of the Contractor's bid. Contractor shall coordinate with private property owners and businesses if required. Landscaping, surface restoration and fence restoration shall be completed within 14 days following construction work. Temporary fencing shall be provided continuously until such private fencing is properly restored.

H. Private Roads and Driveways, Access

1. Contractor shall not block access to private roads or driveways, this includes access to the Owner's facilities.

2. Vehicle and foot access routes shall be provided at all times to allow access to Owner facilities 24 hours a day. Access routes shall accommodate services vehicles and intermittent deliveries to the facilities.

3. When work is adjacent to, or in close proximity of, access routes, the Contractor shall delineate the access route with temporary construction fencing. Temporary interruptions to the access of facilities will be allowed to accommodate work activities in accordance with this Section.

4. Access routes disturbed by construction activities shall be repaired the same day and maintained by the Contractor to ensure safe and reasonable access to the facilities by service vehicles.

I. Stockpiling/Storage Areas – There is limited to no available storage area on site. The Contractor is responsible for obtaining secure off site storage areas and complying to permits and erosion and sediment control standards and regulations.

J. Sidewalk Closure – Limit closure of sidewalk in accordance with any limitations in Right-of-Way Permit. The Contractor shall notify the City in writing 10 business days in advance of sidewalk closure.

1.4 SUBMITTALS

A. Submit a Work Sequencing Plan detailing the complete sequence of construction for all activities contained herein.

B. The Work Sequencing Plan must include all the elements and goals identified herein and as necessary to successfully complete the work. The Work Sequencing Plan shall include but is not limited to:

1. Major work activities to occur.

2. General schedule when work will occur and a separate detailed schedule; incorporate delivery dates of equipment and materials in detailed schedule and work sequencing plan.

3. Proposed modifications to normal facility operations for each major work activity.

4. Number and duration of process interruptions/shutdowns required.

5. Facility, equipment, or utility to be shutdown.

6. Description of the equipment to be used, including temporary equipment during shutdowns.

7. Description of the assistance that will be required of Owner's operating personnel during shutdowns.

8. Contingency backup plan identifying what action will be taken if activities during a shutdown cannot be completed within the allotted times, or if there is a failure of the Contractor's temporary equipment.

1.5 PERMITS

A. The Contractor shall prepare and submit the following permit applications for the project to City of Fircrest. The Contractor is responsible for securing the permits in a timely manner to avoid delaying the construction schedule.

1. Electrical

B. The Owner will obtain the permits listed below.

1. Right of Way – City of University Place
2. Right of Way – City of Fircrest

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS FOR EXECUTION OF WORK

A. Maintain overall coordination of execution of Work.

B. Obtain subcontractor/supplier schedules and assume responsibility for accuracy.

C. Incorporate schedules from all parties into Progress Schedule to plan for and comply with sequencing constraints.

D. Pre-locate by exploratory excavation of existing utilities to minimize service interruption and demands on Owner's personnel.

E. Coordinate temporary support of existing utilities within the project vicinity with the utility company.

END OF SECTION

SECTION 01 21 00

MEASUREMENT AND PAYMENT

PART 1 GENERAL

Measurement and payment will be in accordance with the individual prices set forth in the accepted Bid Proposal. Where work is required but does not appear as a separate item in the proposal, the cost for that work shall be included and absorbed in the prices named in the proposal. Contractor shall make a careful assessment when preparing the Bid.

1.1 PAYMENT

A. Lump Sum payment will be paid at the price indicated on the Bid Proposal using the methods specified herein. Where a percentage is used to determine a partial payment of a bid item, the Owner or Owner's Representative shall make the final determination on what percentage shall be used based on input from the Contractor and field observations. Lump sum values will all be broken down into smaller, distinct work portions, in accordance with Section 01 29 73, Schedule of Values.

B. All other work required to complete the WORK specified in the Contract Documents, but not indicated specifically as a pay item, shall be considered necessary and incidental to other bid item(s).

1.2 SCHEDULE OF LUMP SUM ITEMS

A. 1 - Mobilization

Mobilization shall constitute complete compensation for all costs of requirements in the Special Provisions and preparatory work performed by the Contractor, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the site; administrative submittals; premiums on bonds and insurance for the project; and work and operations which must be performed or costs incurred before beginning production work on the various items on the project site. Mobilization also includes, but is not limited to: posting construction identification signs, construction surveying and staking, providing record drawings, securing permits, establishing safety and security measures, submitting the project schedule, providing product/material submittals, attending public meetings and private home owner meetings as stipulated in the Special Provisions. Mobilization costs for all subcontracted work shall be incidental to this bid item. Measurement and Payment shall be Lump Sum in accordance with WSDOT Standard Specifications Section 1-09.7.

B. 2 - Temporary Traffic Control

Payment for temporary traffic control shall be made on a lump sum basis, complete. This pay item shall be considered full compensation for all labor, materials, equipment, and tools necessary or incidental to traffic control. Payment for developing an approved Traffic Control Plan and any requirements identified in the Special Provisions shall be considered incidental to the lump sum price for Temporary Traffic Control and no additional compensation will be made to the CONTRACTOR.

C. 3 - Shoring and Trench Safety

Payment for shoring and trench safety shall be made on a lump sum basis. This pay item shall constitute full compensation for all material, labor and equipment, complete and in place, for work necessary to protect all excavations greater than four fee below existing grade, including all work, materials, and equipment to comply with WAC 296-155 and Washington Industrial Safety and Health Act, Chapter 49.17 RCW. Measurement and payment shall be based on a percentage of the work completed requiring shoring and trench safety.

D. 4 - Temporary Erosion and Sediment Control

Payment for temporary erosion and sediment control shall be made on a lump sum basis. This pay item shall be considered full compensation for all labor, materials, equipment, and tools necessary or incidental to planning, designing, furnishing, installing, maintaining, and removing temporary erosion control measures in accordance with the Contract Documents, Department of Ecology requirements, and City of Fircrest requirements. This includes, but is not limited to, furnishing and installing straw wattles, inlet filters, and other selected BMPs. Measurement and payment shall be based on a percentage of the work completed requiring temporary erosion and sediment control.

E. 5 - Bypass Pumping

Payment for bypass pumping shall be made on a lump sum basis. This pay item shall be considered full compensation for all labor, materials (valves, piping, etc), equipment (pumps, controls, etc), and tools necessary or incidental to planning, designing, furnishing, installing, operating, maintaining, and removing the bypass pumping system in accordance with the Contract Documents, Department of Ecology requirements, and City of Fircrest requirements. Any failure of the bypass pumping system that results in a spill outside of sealed containment, impacts to private or public property, and/or fines from Ecology shall be resolved by and paid directly by the CONTRACTOR. Measurement and payment shall be based on a percentage of the work completed requiring bypass pumping.

F. 6 - Gravity Block Wall

Payment for Gravity Block Wall shall be made on a lump sum basis. This pay item shall be considered full compensation for all labor, materials, equipment, and tools necessary or incidental to excavating and installing the gravity block walls, including grading, leveling, drainage piping, fabric, slope and property protection, backfill, and compaction, as required to provide a complete wall system as indicated in the Contract Documents. Measurement and payment shall be based on a percentage of the work completed for Gravity Block Wall.

G. 7 - Wet Well

Payment for Wet Well shall be made on a lump sum basis. This pay item shall be considered full compensation for all labor, materials, equipment, and tools necessary for modifying the existing wet well and installing the new wet well. This work includes, but is not necessarily limited to, removing the top and portions of the existing wet well, removing accumulated debris from the wet well, cleaning the existing wet well, removing pumps and piping, disposing of all removed materials, backfilling and compacting material in the bottom of the existing wet well, installing the new wet well, coating the new wet well, testing the new wet well, filling the space between the existing and new wet well, and extending the piping connections into the new wet well. Measurement and payment shall be based on a percentage of the work completed for the Wet Well bid item.

H. 8 – Pumps and Piping

Payment for Pumps and Piping shall be made on a lump sum basis. This pay item shall be considered full compensation for all labor, materials, equipment, and tools necessary for procuring, installing, testing, certifications, and training associated with pumps and piping on this Project. This work includes, but is not necessarily limited to, procuring and installing pumps and piping in accordance with the Contract Documents and manufacturer recommendations and requirements, and coating and testing the pumps and piping. Measurement and payment shall be based on a percentage of the work completed for the Pumps and Piping bid item.

I. 9 - Electrical and Controls

Payment for Electrical and Controls shall be made on a lump sum basis. This pay item shall be considered full compensation for all labor, materials, equipment, and tools necessary for procuring installing, testing, certifications, and training associated with electrical and controls on this Project. This work includes, but is not necessarily limited to, conduits, conductors, panels, equipment, and testing of individual components and the systems. This pay item shall be considered full compensation for supporting as well as coordination and integration of the work performed by the Owner's Instrumentation and Control (I&C) Contractor, as identified in Attachment C.

Measurement and payment shall be based on a percentage of the work completed for the Electrical and Controls bid item.

J. 10 - Programming and Integration

Payment for Programming and Integration shall be made on a lump sum basis. This pay item shall be considered full compensation for supporting as well as coordination and integration of the work performed by the Owner's Instrumentation and Control (I&C) Integrator, as identified in Attachment C. Measurement and payment shall be based on a percentage of the work completed for the Programming and Integration bid item.

K. 11 - Lift Station Miscellaneous

Payment for Lift Station Miscellaneous shall be made on a lump sum basis. This pay item shall be considered full compensation for anything not covered by other pay items. This work includes, but is not necessarily limited to, stump removal, clearing and grubbing, dewatering, excavation not associated with gravity block walls, concrete surfacing, generator concrete pad, and restoration and landscaping. Measurement and payment shall be based on a percentage of the work completed for the Lift Station Miscellaneous bid item.

L. 12 - Generator

Payment for Generator shall be made on a lump sum basis. This pay item shall be considered full compensation for everything required to procure, install, test, and commission the generator, including a full tank of fuel at the completion of startup and training that is not included under other pay items. Measurement and payment shall be based on a percentage of the work completed for the Pumps and Piping bid item.

M. 13 - Fencing

Payment for Fencing shall be made on a lump sum basis. This pay item shall be considered full compensation for all labor, materials, equipment, and tools necessary or incidental to procuring and installing the fencing system identified in the contract documents, including all gates with locking systems and fence post installation whether installed in the top of gravity block wall or elsewhere. Measurement and payment shall be based on a percentage of the work completed for Fencing.

N. 14 - Startup and Commissioning

Payment for Startup and Commissioning shall be made on a lump sum basis. This pay item shall be considered full compensation for all labor, materials, equipment, tools, manufacturer training and inspection, and anything else required to startup and commission the lift station prior to acceptance by the Owner. No measurement shall apply to Startup and Commissioning pay item. Payment shall be made in full once the lift station project is complete and has been accepted by the Owner.

O. 15 – Power Service Relocation and Coordination

Payment for Power Service Relocation and Coordination shall be made on a lump sum basis, if these efforts are required. The existing utility meter and main disconnect has recently been relocated by the power utility company and the location may not be conducive to the project. During construction, field layout of the gravity block wall and fencing locations will be evaluated and finalized. If the existing meter and main disconnect cannot be avoided, this pay item will cover all labor, materials, equipment, and tools necessary to relocate the service, meter, and main disconnect panel from the existing location to the location shown on the electrical drawings. Payment shall also cover all coordination with the power utility company. Measurement and payment shall be based on a percentage of the work completed associated with this pay item. If no relocation is required, no payment shall be made on this pay item.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 29 73

SCHEDULE OF VALUES

PART 1 GENERAL

1.1 GENERAL

This Section defines the process whereby the Schedule of Values (lump sum and per unit price breakdown, where applicable) shall be developed. The Schedule of Values shall be developed independent but simultaneous with the development of the critical path method schedule activities and logic.

1.2 SCHEDULE OF VALUES

A. The Contractor shall submit a preliminary Schedule of Values for the major components of the Work at the Preconstruction Conference. Schedule of values breakdown shall correspond to the task activities in the project schedule and shall total the current Contract Price. The listing shall include, at a minimum, the proposed value for the following major Work components:

1. Mobilization
2. Temporary Traffic Control
3. Shoring and Trench Safety
4. Temporary Erosion and Sediment Control
5. Bypass Pumping
    a. Pumping System Submittal
    b. System Installed and Tested
    c. Diversion/Bypass of Wastewater
    d. System Bypass Operation and Maintenance
    e. System Decommissioning and Removal
6. Gravity Block Wall
    a. Block Wall System Submittal
    b. Excavation and Subgrade Preparation
    c. Block Wall Installation
    d. Drainage System and Backfill

7. Wet Well
    a. Clean Existing Wet Well
    b. Fill and Compact Base Rock
    c. New Wet Well Structure
    d. Piping Connections and Leakage Testing
    e. Fill Annular Space
    f. Sloped Concrete Bottom
8. Pumps and Piping
    a. Pumping System Submittal
    b. Pumping System Installation
    c. Pumping System Testing
    d. Pump Manufacturer Certification of Proper Installation
9. Electrical and Controls
    a. Utility Service Extension
    b. Electrical and Controls Submittals
    c. Main Control & SCADA Panel
    d. Pump Terminal Panel
    e. Site Electrical
    f. Instrumentation
    g. System Testing
10. Programming and Integration
    a. Services Contracted with City's designated I&C Systems Integrator
    b. Coordination with City's designated I&C Systems Integrator
11. Lift Station Miscellaneous
    a. Stump Removal
    b. Clearing and Grubbing
    c. Excavation and Grading
    d. Concrete Flatwork
    e. Generator Pad
    f. Restoration and Landscaping

12. Generator

    a. Generator Submittal

    b. Generator Installation

    c. Generator Testing and Startup

13. Fencing

14. Startup and Commissioning

B. The Contractor and Owner shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the Owner, these are necessary to establish fair and reasonable allocation of values for the major Work components. Front end loading will not be permitted. The Owner may require reallocation of major Work components from items in the above listing if in the opinion of the Owner such reallocation is necessary. This review and any necessary revisions shall be completed within fifteen (15) days from the date of Notice to Proceed.

C. Work changes which add activities not included in the original Work shall have values assigned as approved by the Owner. Other activity values shall be reduced to provide equal value adjustment increases for added activities, as approved by the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 DESCRIPTION

A. Work of this Section is bound by the Specifications and Special Provisions except as modified herein.

B. General: Prepare and process submittals as required by this Section.

C. Administrative Submittals: Submittals required by the Contract Documents that are not shop drawings or samples, or that do not reflect quality of product or method of construction. Administrative submittals may include, but may not be limited to those identified below:

1. Construction progress schedules
2. Shop drawing submittal schedule
3. Work sequencing plan
4. Traffic control plan
5. Erosion/sedimentation control plan
6. Schedule of values
7. Material certificates
8. Quality control
9. Manufacturer's instructions
10. Applications for progress payments and materials invoices
11. As-constructed drawings
12. Proposed training program and schedule
13. Proof of all required insurance (due 10 days after award, unless otherwise stated)
14. Operation and maintenance manuals

1.2 DEFINITIONS

A. Administrative Submittals: Submittals required by the Contract Documents that are not shop drawings or samples, or that do not reflect quality of product or method of construction.

B. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action.

C. Informational Submittals: Written and graphic information and physical Samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.3 SCHEDULE OF SUBMITTALS

A. Within 10 days after the Effective Date of the Contract, Contractor shall submit to Engineer a preliminary Schedule of Submittals, including proposed list of major products proposed for use, with specification section reference, name of manufacturer, supplier, trade name, subcontractor and model number of each product. Provide a schedule of specific target dates for the submission and return of submittals and shop drawings required by the Contract Documents.

B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

C. The list and schedule shall be updated and resubmitted when requested by the Engineer.

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

1.4 SUBMITTAL PROCEDURES

A. Submittals shall be submitted electronically in searchable PDF format via email or other electronic delivery method. Where samples are required, the cover sheet shall still be submitted electronically, and Contractor shall deliver samples to the Owner’s office.

B. Submittal Transmittal Cover Sheet: Completely identify each submittal and re-submittal with the following information:

1. Name, address, phone and e-mail of submitter and contact person

2. Name of Project

3. Status of submittal, if original or resubmit and number of resubmittal

4. Submittal number: Submittals shall be numbered sequentially according to submission time. For example, the first product submittal would be “001”. Resubmittals of that submittal would be “001a”, followed by “001b”, and so on. The second product submittal would be “002”. Alternative method of numbering may be used if acceptable to Engineer.

5. Submittals should indicate the relevant specification section. Submittals containing product information from multiple sections of the specifications will not be reviewed. Contractor and/or their supplier shall divide submittals in a manner that meets the numbering and tracking system requirements stated herein.

C. Transmit each submittal with Engineer-accepted transmittal form certifying compliance with requirements of Contract Documents.

D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.

E. Coordinate submission of related items.

1. All shop drawings for interrelated items shall be scheduled for submission at the same time.

2. The Engineer may hold shop drawings in cases where partial submission cannot be reviewed until the complete submission has been received or where shop drawings cannot be reviewed until correlated items affected by them have been received. When such shop drawings are held, the Engineer will advise the Contractor in writing that the shop drawing submitted will not be reviewed until shop drawings for all related items have been received.

F. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.

G. Allow space on submittals for Contractor and Engineer review stamps or comments.

H. When revised for resubmission, the Contractor shall identify changes made since previous submission. A narrative of changes shall be provided, and shop drawings or calculations shall indicate that a revision was made.

I. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with review comments.

J. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

K. The technical provisions may not list all submittal requirements specific to that section (i.e., shop drawings, samples, product data, etc.). Instead, the Contractor shall make complete submittals for all methods and all materials and all products to be incorporated into the project. This requirement shall apply even when the Contractor proposes to use the same materials, methods, and products that are specifically identified in the Contract. The submittal requirements listed in this Section will apply to all Technical Specifications whether or not specific requirements are listed.

1.5 ENGINEER REVIEW

A. Unless otherwise specified in the Technical Specifications, the Engineer shall review the submittal within fourteen (14) calendar days after receipt of the submittal for review and return the marked up copies to the Contractor.

B. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.

C. The Engineer’s review of submittals and shop drawings is not a check of any dimension or quantity and will not relieve the Contractor from responsibility for errors of any sort in the submittals and shop drawings.

D. Submittals made by Contractor that are not required by Contract Documents may be returned without action.

E. The Engineer will review the submitted data and shop drawings and return to the Contractor with notations thereon indicating "No Exception Taken", "Make Corrections Noted", "Rejected", or "Amend and Resubmit".

1. If the review indicated that the material, equipment or work method complies with the project manual, submittal copies will be marked "No Exceptions Taken". In this event, the contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.

2. If the review indicated limited corrections are required, copies will be marked "Make Corrections Noted". The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in O & M data, a corrected copy will be required.

3. If review reveals that the submittal is insufficient or contains incorrect data, copies will be marked and returned with "Amend and Resubmit". Except at its own risk, the Contractor shall not undertake work covered by this submittal until it has been revised, resubmitted and returned noted either, "No Exceptions Taken" or "Make Corrections Noted".

4. If the review indicated that the material, equipment or work method does not comply with the project manual, copies of the submittal will be marked, "Rejected". Submittals with deviations which have not been identified clearly may be rejected. The Contractor shall not undertake the work covered by such submittals until a new submittal is made and returned marked either "No Exceptions Taken" or "Make Corrections Noted".

F. If more than two (2) submissions of an item are required to meet the Project specifications, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

G. Engineer's review will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

H. Engineer's review of a separate item as such will not indicate approval of the assembly in which the item functions.

I. Engineer's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has clearly indicated the deviation(s) from the Contract Documents and Engineer has given written acceptance of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such accepted variation from the requirements of the Contract Documents in a Field Order.

J. Engineer's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of the Contract Documents.

K. Engineer's review of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

L. Neither Engineer's receipt, review, return of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

M. Contractor shall perform the Work in compliance with the requirements and commitments set forth in returned Shop Drawings and Samples.

1.6 RESUBMITTAL PROCEDURES

A. 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. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

B. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required review of an item with no more than two submittals. Engineer will record Engineer's time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring review, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

C. If Contractor requests a change of a previously reviewed submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 41 20

SEISMIC REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 GENERAL

1.1 SUMMARY

A. This section contains seismic design requirements for non-structural equipment, components, and systems. The components and systems indicated below are required for immediate re-occupancy and minimization of disruption to operations following a seismic event. All elements shall meet the requirements of this Section and Chapter 13 of ASCE 7-16.

B. Applicable Specification Divisions include those with:

1. Components that are part of the Designate Seismic Systems, as covered in the 2018 IBC Section 1705.13.3 and are subject to the requirements of ASCE 7 Section 13.2.2.

2. Components weighing more than 400 pounds that have a center of mass located 4-feet or less above the adjacent floor or roof level that supports the component.

3. Components weighing more than 20 pounds, or more than 5 pounds per foot in the case of distributed systems, located more than 4 feet above the adjacent floor or roof level that supports the component.

4. Exceptions:

    a. Furniture

    b. Temporary or movable equipment

1.2 ACCEPTED STANDARDS

A. ASCE 7-16 Section 13.2.2 requires certification be provided for mechanical, electrical, and containment and storage equipment that is identified as being assigned to the Designate Seismic System. This designation requires said systems to remain operable and functional following the design earthquake ground motion. Documentation confirming suitability shall be provided as outlined in the submittal section below.

B. ASCE 7-16 Section 13.1.7 allows for the use of reference documents or standards for industry specific systems or components that represent acceptable procedures for seismic design and construction. The use of these documents or standards does not alleviate the Contractor from submitting calculations, drawings, and product data that show conformance to the requirements of this Section.

C. Pre-approved details meeting the requirements of ASCE 7-16 Section 13.3 may be used for this project without submitting calculations indicating compliance with the design criteria specified in the design criteria section below. The Contractor shall provide shop drawings detailing the product and specifying the pre-approved detail(s) to be used and their locations along with supporting documentation.

1.3 SUBMITTALS

A. Special Certifications for the Designated Seismic System:

1. For active Mechanical and Electrical Equipment, submit one of the following forms of documentation for each main component of the system.

a. Approved Shake Table Test results per ASCE 7 Section 13.2.5.

b. Experience Data per ASCE 7 Section 13.2.6.

c. Inherent Ruggedness per ASCE 7 Section 13.2.5.

2. For non-active Mechanical and Electrical Equipment, submit one of the following forms of documentation for each main component of the system.

a. Analysis per ASCE 7 Section 13.2.2.

b. Approved Shake Table Test results per ASCE 7 Section 13.2.5.

c. Experience Data per ASCE 7 Section 13.2.6.

3. For component with hazardous substances, submit on of the following forms of documentation for each main component of the system.

a. Analysis per ASCE 7 Section 13.2.2.

b. Approved Shake Table Test results per ASCE 7 Section 13.2.5.

c. Experience Data per ASCE 7 Section 13.2.6.

B. Product Data: Illustrate and indicate style, material, strength, fastening provision and finish for each type and size of seismic restraint component used.

C. Shop Drawings: Submit shop drawing plans and details indicating horizontal and vertical location (with respect to floor/roof level and grids) layout, spacing, sizes and types of seismic restraint and gravity supports for each system or component requiring bracing. The connection details shall be on similar size plan sheets and clearly presented in the electronic submittal document. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices. Shop drawings shall be stamped by a registered Structural Engineer licensed in the State where the

project is located. The shop drawings must be clearly organized and presented such that they can be readily interpreted by the Contractor for installation and the Special Inspector or Owner. Include the following:

1. Fabricated Support: Representations of field-fabricated supports not detailed on the Shop Drawings.

2. Seismic Restraints: Detail anchorage and bracing not defined by other details or charts on the Shop Drawings. Include the following:

    a. Design: To support selection and arrangement of seismic restraints, include calculations of combined tensile, compressive, and shear loads. NOTE: Anchorage to concrete shall comply with ACI 318-14, Chapter 17 assuming cracked concrete conditions.

    b. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events.

D. Calculations: Calculations shall be submitted together with the Shop Drawings. Calculations shall substantiate the design of the sizes, thicknesses, and types of seismic restraint connections, gravity support connections, fabrication, and attachment (fastening, anchorage, welding, etc.) to the structure, including all fasteners. Calculations shall clearly indicate the loads imposed on the primary building structure, including magnitude, direction, and location. Calculations shall be based on the design requirements in this Specification and shall be stamped by a registered Structural Engineer licensed in the State where the project is located.

E. Welding certificates of welders performing component or system installation.

F. Field Quality Control reports

G. Field Observation Reports from the Special Inspector

1.4 QUALITY ASSURANCE

A. Comply with seismic restraint requirements in ASCE 7-16 unless requirements in this Specification are more stringent.

1.5 DESIGN CRITERIA

A. General – Seismic Demands on Non-Structural Components per ASCE 7-16 Section 13.3 are superseded by Sections 1.6B and 1.6C below. Conform to all other sections of ASCE 7-16 Chapter 13.

B. Horizontal Seismic Forces – Design and detail all members and connections to meet the requirements of ASCE 7-16 based on the actual system or component operating weight. The design and evaluation of components and their support and attachments shall consider their flexibility as well as their strength. The following forces shall be used for all design and calculations.

1. Site Class C

2. Risk Category IV

3. F_p = horizontal seismic design force applied in any direction

   $F_p = 0.4\ S_{DS}\ [(a_p W_p)(1+2z/h)]/R_p/I_p)$

   $F_{pMAX} = 1.6\ I_p\ S_{DS}\ W_p$

   $F_{pMIN} = 0.3\ I_p\ S_{DS}\ W_p$

4. a_p = component amplification factor, per ASCE 7-16 Chapter 13, unless specified elsewhere within individual specifications.

5. R_p = component response modification factor, per ASCE 7-16 unless specified elsewhere within individual specifications.

6. W_p = component operating weight

7. I_p = 1.5, component importance factor

8. z = height (in feet) above ground floor for the attachment of the component (see drawings for floor elevations). z shall be taken as zero below grade. The value of z/h need not exceed 1.0.

9. H = roof height above grade

10. S_{DS} = 1.033, Short Period Design Spectral Response Acceleration per the project Geotechnical Report

C. Vertical Seismic Forces – Calculate vertical seismic force by the following equation. The design force shall be applied vertically at the center of gravity of the component or distributed according to the mass distribution of the component or system. The vertical seismic force shall be combined with the horizontal seismic force as well as the Dead Load gravity force to determine the maximum force for component or anchorage design. Combine horizontal and vertical effects as indicated in ASCE 7-16, Section 13.3.1.

$F_{pV} = +/-0.2\ S_{DS} W_p$

D. Seismic attachments, bracing, and anchorage shall be designed such that the component force is transferred to the lateral force resisting system of the structure through a complete load path. Attachments shall not be made across expansion and contraction joints.

E. Components with vibration isolation systems shall have snubbers in each horizontal direction and vertical restraints as necessary to resist overturning.

F. The seismic anchorage system shall provide restraint in all directions, including vertical, for each component or system for which seismic design is required.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section covers quality control requirements supplementary to those of the Standard Specifications, General Conditions, and Technical Specifications.

1.2 PROVISIONS

A. Contractor's Responsibility for Testing

The Contractor shall be responsible for the cost of all testing as specified in this section. Additional information has been provided regarding the payment responsibility for the Owner with regards to the Project.

B. Owner's Right to Perform Additional Tests

The Owner or Engineer reserves the right to complete additional testing. In such cases, the Contractor shall provide safe access for the Owner or Engineer and their inspectors to adequately inspect the quality of work and the conformance with project specifications.

1.3 QUALITY ASSURANCE

A. Testing Requirements

An independently owned and operated laboratory approved by the Engineer shall perform all testing as specified herein.

B. Testing

1. General

a. All required testing of work and/or materials shall be conducted in the presence of the Engineer. The Contractor shall provide forty-eight (48) hour notification to the Owner and Engineer prior to conducting any and all quality assurance testing. Where applicable, work and materials shall only be buried with the consent of the Engineer.

b. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample or samples of material to be tested shall be

selected by such laboratory or agency or by the Engineer. The Contractor shall furnish such samples of all materials without charge to Owner.

c. The results from any and all tests are made for the information of the Owner. Regardless of any test results, the Contractor is solely responsible for the quality of workmanship and materials and for compliance with the requirements of the Contract Documents.

2. Costs of Testing

a. The Contractor shall be responsible for and shall pay for all tests as specified in Part 3 of this Section. Additional information has been provided regarding the payment responsibility for the Owner with regards to the Project.

b. With regards to all materials to be tested, where test results demonstrate that the material or workmanship does not meet the minimum requirements of the Contract Documents, additional testing shall be completed and shall be paid for by the Contractor with no reimbursement by the Owner.

1.4 SPECIAL INSPECTIONS

Special inspections and testing as required by Chapter 17 of the IBC shall be conducted by Owner-retained Special Inspectors and Testing Agencies as required and as indicated in the Contract Documents.

A. Special Inspectors and Testing Agencies Responsibilities

1. Verify that manufacturers maintain detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.

2. Promptly notify Owner and Contractor of irregularities and deficiencies observed in the Work during performance of their services.

3. Submit certified written report of each test, inspection and similar quality control service to Owner, Contractor and jurisdictional authorities. Interpret test results and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

4. Submit final report of special inspections at Substantial Completion, including a list of unresolved deficiencies.

5. Re-test and re-inspect corrected work.

B. Contractor's Responsibilities

1. Provide quality requirements to all subcontractors and enforce all requirements.

2. Notify Owner, Engineer, Special Inspectors and Testing Agencies at least 48 hours in advance of time when Work that requires testing or special inspecting will be performed, unless otherwise indicated in the Contract Documents.

3. Pay for any Contractor requested testing and inspecting not required by the Contract Documents.

4. Pay for any re-testing or re-inspections by Special Inspectors and Testing Agencies for replacement work resulting from work that failed to comply with the Contract Documents. Owner will deduct such costs from the Contract Price.

5. Submit copies of licenses, certifications, correspondence, records and similar documents used to establish compliance with standards and regulations that pertain to performance of the Work to the Owner, Engineer and Special Inspectors.

6. Where Special Inspection requires pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:

    a. Provide test specimens representative of proposed products and construction in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

    b. Provide information on configurations of test assemblies, testing procedures and laboratory test records to adequately demonstrate capability of products to comply with performance requirements.

7. Cooperate with Agencies performing required tests, special inspections and similar quality control services. Notify Agencies in advance of operations to permit assignment of personnel. Provide the following:

    a. Access to the Work.

    b. Incidental labor, equipment and materials necessary to facilitate tests and special inspections.

    c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist Agencies in obtaining samples.

    d. Provide facilities for storage and field curing of test samples.

    e. Deliver samples to Testing Agencies.

8. Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and special inspecting.

9. Schedule times for tests, special inspections, obtaining samples and similar activities. Distribute schedule to Owner, Engineer, Special Inspectors, Testing Agencies and each party involved in portions of the work where tests and special inspections are required.

1.5 SUBMITTALS

A. Laboratory Test or Inspection Reports

Each report shall be signed and certified by the independently owned and operated testing laboratory. Unless otherwise specified, submit three (3) copies of each report to the Owner or Owner's Representative.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 FIELD TESTING SCHEDULE

A. The Contractor shall complete field testing in accordance with the following schedule. Additional source material testing shall be completed as necessary to establish the basis of field tests. The frequency of testing listed in this schedule lists the minimum number of tests per quantity of work completed by the Contractor. Testing locations to be determined by the Engineer.

Material to be Tested	Payment Responsibility	Minimum Testing Frequency
Backfill	Contractor	In-place compaction testing (w/ nuclear compaction gage) performed at 2-foot maximum elevation increments.
Aggregate Foundation and Leveling Pads	Contractor	In-place compaction testing (w/ nuclear compaction gage) performed at each end of foundation or gravity block wall leveling pad just prior to installing blocks/structures.
Concrete	Contractor	As required when placed. See detailed requirements in Section 03 30 00, Concrete Work.

END OF SECTION

SECTION 01 46 00

PIPELINE TESTING

PART 1 GENERAL

1.1 DESCRIPTION

A. This Section covers field pressure testing of all pressure piping, fittings, and valves. All pressure pipe shall be hydrostatically pressure and leak tested. Defective items revealed by the testing procedures shall be removed and replaced or otherwise corrected, as directed by the Engineer. All costs for labor and materials necessary to conduct the testing procedures specified herein, and all costs of labor and materials required to remedy defective items shall be borne by the Contractor.

B. Contractor shall provide 71-hour notification to Engineer and Owner prior to conducting testing. Contractor shall provide coordination and scheduling required for the Owner and Engineer to witness. Contractor shall not operate any part of the existing water or sewer system.

C. Contractor shall perform flushing and testing of all pipelines and appurtenant piping, complete, including conveyance of test water to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. A testing schedule, including proposed plans for water conveyance and control shall be submitted in writing for approval a minimum of one (1) week before testing is to start.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. All test equipment, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor, subject to Engineer's review. No materials shall be used that would be injurious to the Project or its future functions.

B. As a minimum, Contractor shall furnish the following equipment and materials for the test:

Quantity	Description
2	Graduated containers approved by the Engineer
1	Hydraulic pump approved by the Engineer with hoses, valves, and fittings as required for the testing and disinfection of the facilities.
2	Pressure gauges with pressure range at least 120% greater than the required maximum test pressure with graduations in two (2) psi increments. The gauge must be calibrated within 90 days of any pressure test.

PART 3 EXECUTION

3.1 PRESSURE PIPE TESTING

A. Contractor shall make all necessary provisions for conveying water to the points of use and for the disposal of test water.

B. All piping shall be tested under a hydrostatic test pressure no less than 100 psi (+/- 5 psi) at the highest point along the test section or as shown on the plans. Testing shall be performed by filling the pipe with water, allowing natural absorption to occur, and applying the specified test pressure by pumping. Once the test pressure has been attained, the pump shall be valved off. The test shall be conducted for one (1) hour with the allowable leakage not to exceed value calculated below.

C. During the test, pipe, fittings, and valves with welded and/or flanged joints shall be completely tight. Pipe, fittings, and valves with rubber gasketed joints (mechanical joints or push-on joints) shall have a measured loss not to exceed the rate given in the following formula:

$$AL = \frac{LD(P)^{\frac{1}{2}}}{148{,}000}$$

In the above formula:

AL = Allowable leakage, in gallons per hour
L – Length of pipe tested, in feet
D – Nominal diameter of pipe, in inches
P = Average test pressure during the leakage test, in pounds per square inch

D. During the test period, operate the pump to pressurize the pipe system within 5 psi of the specified test pressure. At the end of the test period, operate the pump until the specified test pressure is again obtained. The pump suction shall be in a graduated barrel or similar device or metered so that the amount of water required to restore test pressure may be accurately measured.

E. If the test reveals any defects, leakage in excess of the allowable limits, or failure, Contractor shall furnish all labor, equipment, and materials required to locate and make necessary repairs. The testing of the line (and repairing of defects, excessive leakage, and failures) shall be repeated until a test satisfactory to the Engineer has been achieved. All costs for locating, repairing, and retesting shall be borne by the Contractor.

3.2 GRAVITY PIPE TESTING

A. General: Gravity pipelines shall be subject to acceptance tests. Contractor shall provide the necessary utilities, labor, and facilities for testing and shall dispose of waste, including water.

B. Testing

1. Obstructions: After backfilling and restoration of surfaces, gravity pipelines shall be inspected for obstructions and shall be cleaned. Pipes less than 24 inches in diameter shall be cleaned using the sewer ball method. Lines larger than 36 inches in diameter may be cleaned by flushing as long as they are first visually inspected to assure that no physical obstructions exist. Flushing shall be such that velocities are at least 2.5 feet per second.

2. Leakage: Gravity pipe drain lines, including interior buried and encased lines, shall be tested for leakage after backfilling. Contractor shall take necessary precautions to prevent joints from separating while the piping or their appurtenances are being tested. The Contractor shall, at the Contractor's own expense, correct any excess leakage and repair any damage to the pipe and appurtenances or to any structures resulting from or caused by these tests. No pipe sealant will be allowed in repair. Where required by the Engineer, the line shall be retested at the Contractor's expense to meet the Specifications.

    a. Test method shall be either hydrostatic with APWA 303.3.09B or air in accordance with APWA 303.3.09C.

    b. Where the actual leakage exceeds the APWA standards, Contractor shall determine the cause and repair it before the pipe will be accepted. If the leakage is less than allowable and leaks are observed at a particular point, such leaks shall be repaired at the Engineer's direction and the Contractor's expense.

c. At any time during the construction period, if there is any evidence to indicate excess infiltration or defect in any run of pipe, then the run shall be rejected and the Contractor shall correct said leakage or defect at no expense to the Owner.

END OF SECTION

SECTION 01 51 50

TEMPORARY PUMPING AND PIPING

PART 1 GENERAL

1.1 DESCRIPTION

A. The existing lift station continuously pumps wastewater to a gravity sewer system up the hill and to the east. The functions of the existing lift station shall not be compromised during the course of the Work except as specified herein. Contractor shall plan and execute the Work such that operation of the lift station is not interrupted.

B. Pumping disruptions could potentially result in a spill or discharge of municipal wastewater. State law allows the Washington Department of Ecology to impose civil penalties for wastewater spills or discharges. A person who unlawfully pollutes water is subject to criminal prosecution.

C. Wastewater spills or discharge to surface waters or drainage courses is prohibited. Penalties imposed on Owner as a result of any bypass caused by Contractor, Contractor's employees or subcontractors, and legal fees and other expenses to Owner resulting directly or indirectly from the bypass shall be borne in full by Contractor.

D. Contractor is responsible to plan, schedule, and sequence construction activities to ensure that pumping of wastewater at all times is uninterrupted.

E. Contractor shall be responsible for controlling any and all leakage resulting from or integral to all temporary and permanent piping connections and shall provide any and all devices required to control, stop, divert, or dispose of any and all leakage.

1.2 SUBMITTALS

A. Submit a Temporary Pumping and Piping Plan for approval of Contractor's planned bypass. Submit plan a minimum of four weeks prior to the proposed date of installation of the bypass pumping system. Do not construct or place temporary process pumping and piping facilities until the Owner and Engineer have reviewed and provided a response to the proposed plan(s).

B. Include the following information, at a minimum, in proposed plan:

1. Name, qualifications, and references of subcontractor providing pumping facilities, including jobs of similar scope and complexity completed by the proposed subcontractor.

2. Description of pumps to be used, including pump curves and calculation of pumping capacity required.

3. Description of control equipment and temporary control panel(s) and method used to operate the pumps.

4. Pump maintenance plan describing regular maintenance to be performed while the pumps are in service and the length of the maintenance period when a pump will be out of service.

5. Contingency plan describing steps to be taken if a pump fails and emergency contact phone numbers.

6. Noise levels at minimum and maximum operating speed.

7. Drawing showing layout and routing of bypass pumping equipment, piping, and valves with associated sizes and dimensions.

8. Alarms sent to Owner's central control facility.

9. Method of securing bypass pumping system from vandalism.

10. Results of field pressure test of temporary piping, submitted prior to temporary pumping operation.

1.3 CONTINUITY OF LIFT STATION OPERATION

A. The existing lift station will be demolished during construction. Bypass pumping systems must be kept in operation through the use of existing or temporary systems, except as specified herein, until the new facilities are capable of accepting raw sewage and accepted by the Owner.

B. Minimum Pumping System: Through the use of permanent or temporary pumps, the Contractor shall maintain the following minimum pumping ability at all times during construction:

1. Firm capacity (each pump): 200 gpm

2. Redundancy: Contractor shall provide on-site, installed and ready for operation, a complete redundant pump equal to or larger than the required firm capacity.

3. Primary Power: Contractor shall obtain temporary power source through Tacoma Power for operating the temporary bypass pumps. Engine-driven pumps will not be allowed as the lead pumping system.

4. Backup Power: An engine-driven generator shall be provided on-site, installed and ready for operation, in the event of a power failure. As an alternative, Contractor may propose the backup (second) pump as engine-driven to serve as backup in the event of primary pump failure or power failure.

5. Noise Standard: The Contractor shall use critically silenced generators and pump units with hospital-grade mufflers. Temporary pumping system shall meet all local, State, and City noise standards for operation in a residential environment. Such approved generators and accompanying pumps shall be continuously monitored while in operation and shall be placed to minimize disturbances to residential areas. No variance from any local noise ordinances will be allowed unless the Contractor secures a noise variance at no additional expense to the Owner.

PART 2 PRODUCTS

2.1 TEMPORARY BYPASS PUMPING EQUIPMENT

A. Operation of temporary equipment shall be automatic unless manually operated by the Contractor's staff 24 hours per day.

B. Alarms: Provide high level and overflow level floats for the temporary system with telemetry to 24-hour Contractor monitored and provided service.

2.2 TEMPORARY PIPING

A. Provide temporary piping, valves, and fittings for temporary pumping equipment.

B. Provide pipe or hose and couplings rated for 200% of operating pressure.

PART 3 EXECUTION

3.1 OPERATION

A. Contractor shall respond to and resolve all alarms from temporary pumping operations. Contractor's point of contact shall be located within 30 minutes of the project site to ensure rapid response to alarms.

B. Contractor shall be responsible for ensuring that the temporary bypass pumps are maintained and remain operational 24 hours per day, 7 days per week for the duration of the bypass pumping.

C. Contractor shall notify the Owner immediately in the event of an extreme high level alarm. Owner will provide Contractor with names and telephone numbers of personnel to be contacted in the case of an alarm or other emergency.

D. No bypass pumping operations may proceed unless the Contractor has the following items at the work site:

1. Equipment to secure the area of sewage release and isolate the public from accessing the release site. As a minimum, this shall include barricades and caution tape.

2. The equipment and materials, on hand, to stop the release and repair the failed item.

3. Equipment and materials to clean the site, rake up solid debris, and to dispose of material properly.

E. In case of sewage release during diversion operations, the Contractor shall immediately contact the following authorities, notifying them of the release:

1. Owner's Representative

   The Owner's Representative shall report the sewage spill within 24 hours to the Washington State Department of Ecology and any other appropriate entities. Even if a sewage spill or release is contained within an excavation, the spill or release must be reported.

   Failure by the Contractor to report a spill or release to the appropriate City representative will result in liquidated damages in the amount of $500.00 per incident plus an amount sufficient to reimburse the City for any civil and administrative penalties paid by the City as a result of the Contractor's failure to report as described above.

F. The Contractor shall be responsible for providing the following information to the authorities in case of a spill or release:

1. Release location

2. Date and time release found or started and time stopped

3. Release flow rate and estimated total volume

4. Receiving stream, if any

5. Action taken to stop release

6. Cause of release

7. Clean-up actions taken

8. Any other information requested by relevant authorities

G. Temporary Piping – Route temporary piping to avoid blocking construction equipment and residential property access. Provide protection for piping and couplings where crossing access points is unavoidable. Temporary piping shall be buried or arranged such that piping is protected from traffic loads, traffic is maintained at driveways and roadways, and sidewalks are free of obstruction unless otherwise approved by the Engineer.

H. Testing

1. Pressure test temporary piping to a pressure of no less than 150% of operating pressure prior to placing into operation and submit test results to Engineer.

2. Prior to operation, provide a functional test for the complete temporary pumping system including pumps, valves, alarms, telemetry, and redundancy.

END OF SECTION

SECTION 01 66 00

PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes general requirements for delivery, handling, and storage of products and materials.

1.2 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General:

1. Access routes, staging areas, loading restrictions, and other uses of the project site shall be coordinated and approved by the Owner prior to the start of work. Ease of access to the project site is limited and shall be verified prior to moving materials.

B. Deliver, store, and handle products according to the manufacturer's recommendations, using means and methods that will prevent damage, deterioration, and losses, including theft.

1. Deliver products to the site in the manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing to prevent damage, deterioration, loss, or theft. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage. Where appropriate, submit MSDS for all delivered products.

2. Schedule delivery to minimize long-term storage at the project site and to prevent overcrowding of construction spaces.

3. Coordinate delivery with installation time to assure minimum holding time for items that are flammable, hazardous, easily damage, or sensitive to deterioration, theft, and other losses. Store sensitive products in weather tight, climate controlled enclosures in an environment favorable to product.

a. Store all glues, adhesives, sealers, caulking, mastics, cleaners, paints, thinners, and related flammable and hazardous materials with lids sealed and outside or within a storage facility approved for such use.

4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that quantities are correct and that products are undamaged and properly protected. Reject damaged and defective items.

C. Storage:

1. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units. Store and protect in accordance with manufacturer's instructions, with seals and labels intact and legible.

2. Store products subject to damage by the elements above ground, under cover in a weathertight enclosure with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

3. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

4. Prevent contact with material that may cause corrosion, discoloration, or staining.

5. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.3 PROTECTION

A. Protect products after installation.

1. Protect all parts of the structures from damage (from all causes) until Owner's approval.

2. Provide substantial coverings such as boarding, building paper, polyethylene sheeting, and the like, as necessary to protect installed products.

3. Remove coverings when no longer needed.

B. Repair or replace damaged products as required for acceptance by Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 75 16

TESTING, TRAINING AND SYSTEM START-UP

PART 1 GENERAL

1.1 SUMMARY

This section specifies equipment and system testing and start-up, services of manufacturer's representatives, training of Owner's personnel and final testing requirements for the complete facility.

1.2 CONTRACT REQUIREMENTS

A. Testing, training and start-up can only commence after complete Operation and Maintenance manuals have been submitted and accepted by the Owner.

B. Testing, training and start-up are requisite to the satisfactory completion of the Contract.

C. Complete all testing, training, and start-up within the Contract Time(s).

D. Furnish all necessary labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.

E. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation, testing, and operator training.

1.3 MANUFACTURER SERVICES

A. The Contractor shall furnish the services of a manufacturer's or material supplier’s representative for all major equipment and materials furnished by the Contractor under this contract, to check, place in operation and test the installation, and train operating personnel.

B. The manufacturer's representative shall be qualified and authorized to perform repairs and maintenance on the equipment.

C. The above gives a general scope of the services desired from the manufacturer's representative. It will be the responsibility of the Contractor and the equipment manufacturer to determine detailed requirements.

D. Costs for services of the manufacturer's representative shall be included in the proposal of the Contractor.

E. The operator training mentioned above shall include sufficient time during the Contractor's operation and testing period to fully explain to the operating personnel the features of the equipment and maintenance thereof.

1.4 START-UP PLAN

A. Submit start-up plan for each piece of equipment and each system not less than eight (8) weeks prior to planned initial equipment or system start-up.

B. Provide detailed Start-up Progress Schedule with the following activities identified:

1. Manufacturer's services
2. Installation certifications
3. Operator training
4. Submission of operation and maintenance manual
5. Operational testing
6. Functional testing

C. Provide testing plan with test logs for each item of equipment and/or system. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.

D. Provide summary of shutdown requirements for existing systems if required, which are necessary to complete start-up of new equipment and systems.

E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.5 GENERAL START-UP AND TESTING PROCEDURES

A. Mechanical Systems:

1. Remove rust preventatives and oils applied to protect equipment during construction.

2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.

3. Flush fuel system and provide fuel for testing and start-up.

4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.

5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.

6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.

7. Perform cold alignment and hot alignment to manufacturer's tolerances.

8. Adjust V-belt tension and variable pitch sheaves.

9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.

10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.

11. Install gratings, safety chains, handrails, shaft guards and sidewalks prior to operational testing.

B. Electrical Systems

1. Perform insulation resistance tests on wiring except 120-volt lighting, wiring, and control wiring inside electrical panels.

2. Perform continuity tests on grounding systems.

3. Test and set switchgear and circuit breaker relays for proper operation.

4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of independent testing lab to perform tests.

5. Check motors for actual full load amperage draw. Compare to nameplate value.

C. Instrumentation Systems

1. Bench or field calibrate instruments and make required adjustments and control point settings.

2. Leak test pneumatic controls and instrument air piping.

3. Energize transmitting and control signal systems, verify proper operation, ranges and settings.

1.6 OPERATIONAL TESTING

A. Meet the specific operational testing requirements of individual equipment specifications as well as the requirements in this section. If specific operational testing requirements are not given, follow the requirements of this section.

B. Test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed.

C. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the manufacturer's representative.

D. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.

1.7 CERTIFICATE OF PROPER INSTALLATION

A. At completion of functional testing, furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:

1. Has been properly installed, aligned, adjusted and lubricated.

2. Is free of any stresses imposed by connecting piping or anchor bolts.

3. Is suitable for satisfactory full-time operation under full load conditions.

4. Operates within the allowable limits for vibration.

5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.

6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly functioning.

B. Furnish written report prepared and signed by the electrical and/or instrumentation subcontractor certifying:

1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.

2. Control logic for equipment start-up, shutdown, sequencing, interlocks and emergency shutdown has been tested and is properly operating.

C. Co-sign the reports along with the manufacturer's representative and subcontractors.

1.8 TRAINING OF OWNER’S PERSONNEL

A. No training of Owner’s personnel is required unless Contractor submits equipment that is not a listed manufacturer. Training time will be determined by the Owner, up to one (1) eight (8) hour day.

1.9 FUNCTIONAL TESTING

A. Conduct functional test of the entire facility after completion of operator training. Demonstrate satisfactory operation of equipment and systems in actual operation.

B. Conduct functional test for continuous seven (7) day period.

C. Owner will provide operations personnel, power, fuel, and other consumables for duration of test.

D. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.

E. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.10 RECORD KEEPING

A. Maintain and submit to Engineer the following records generated during start-up and testing phase of project:

1. Daily logs of equipment testing identifying all tests conducted and outcome.

2. Logs of time spent by manufacturer's representatives performing services on the job site.

3. Equipment lubrication records.

4. Electrical phase, voltage, and amperage measurements.

5. Insulation resistance measurements.

6. Pump torsional and lateral vibration analysis report.

7. Data sheets of control loop testing including testing and calibration of instrumentation devices and set-points.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 77 00

PROJECT CLOSEOUT

PART 1 GENERAL

1.1 SUBMITTALS

A. Closeout Submittals:

1. Contract Record Documents: Submit one (1) set of Drawings and one (1) copy of the Specifications marked as follows:

   a. Each drawing sheet with “CONTRACT RECORD DOCUMENT”

   b. Each modified Specification Section with “CONTRACT RECORD DOCUMENT”

   c. Drawings describing conditions that deviate from original Contract documents:

      1) Mark drawings to show horizontal location, elevation, and dimensions of underground or concealed structures or facilities whose elevations and dimensions vary from those indicated. Reference locations and elevations to permanent surface features.

      2) Indicate changes made by Field Order or Change Order.

      3) Use red indelible pens for record-marking devices.

   d. Submit documents in accordance with Section 01 33 00 – Submittal Procedures with signature of Contractor certifying that said documents are true and complete record of execution of Work.

   e. Deliver all spare parts and extra materials, as required by the Contract Documents.

   f. Submit all warranties/guarantees.

1.2 PREPARATION FOR FINAL INSPECTION

A. Before requesting final inspection for acceptance of the Work by Owner, Contractor shall inspect, clean, and repair the Work as required.

1.3 FINAL INSPECTION

A. When the Contractor considers the Work to be complete, submit written certification that:

1. Contract Documents have been reviewed.

2. Work has been inspected for compliance with the Contract Documents.

3. Work has been completed in accordance with the Contract Documents.

4. Work is ready for final inspection.

B. Project Representative will meet with the Contractor to verify the status of completion with reasonable promptness after receipt of such certifications.

C. If Project Representative finds incomplete or defective Work:

1. Project Representative will promptly prepare a punch list and notify Contractor in writing, listing incomplete or defective Work.

2. Contractor shall take immediate steps to remedy stated deficiencies and send second written certification to Project Representative that Work is complete.

3. Project Representative will re-inspect Work with the Contractor.

D. When Project Representative finds Work is acceptable, Project Representative will recommend issuance of Substantial Completion by Owner and request Contractor to make closeout submittals identified in this Specification.

1.4 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to Project Representative

B. Reflect all adjustments to the Contract Sum in final statement.

1. The original Contract Sum

2. Additions and deductions resulting from:

a. Executed change orders

b. Allowances

c. Unit prices

d. Deductions or uncorrected Work

e. Penalties

f. Deductions for liquidated damages

g. Deductions for re-inspection payments

h. Other adjustments

3. Total Contract Sum, as adjusted

4. Previous payments

5. Sum remaining due

C. Project Representative will prepare a final Change Order, reflecting approved adjustments to the Contract Sum that were not previously made by change orders.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 FINAL CLEANUP

A. At the completion of the Work, leave the premises in a neat and clean condition.

B. Deliver all spare parts and extra materials, as required by the Contract Documents.

C. Repair or replace all construction corridor fencing, landscaping, irrigation systems, paved areas that were disturbed or removed during the Work to as good or better than their preconstruction condition.

D. Remove all temporary construction facilities and restore areas to original or better condition.

E. Remove all tools, materials, debris, and equipment from the premises as soon as possible, upon completion of the Work.

F. Remove erosion and sediment control measures.

END OF SECTION

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SUMMARY

A. Complete operation and maintenance (O&M) manuals covering all equipment and system furnished under the plans and specifications shall be prepared by the Contractor based on payment requests to date.

B. The information shall be prepared for use by the Owner's personnel in the form of an instructional manual.

C. The O&M manual shall include all installation, operation, maintenance, handling, storage, assembly, erection and other pertinent information for all equipment, systems, subsystems, appliances, materials, finishes and other materials furnished and installed on or at the project.

D. Comb bound manufacturer's literature will not be accepted.

1.2 SUBMITTALS

A. The Contractor shall submit to the Owner three (3) copies of the proposed O&M Manual for review by the Owner. After reviewing the manual for compliance with the specifications, the Owner’s comments will be returned with the Manuals to the Contractor for revision.

B. The Contractor shall submit to the Owner three (3) copies of the revised manual for review by the Owner. After reviewing the manual for compliance with the specifications and previous comments, the Owner’s comments will be returned with the Manuals to the Contractor for revision, if any.

C. Near completion of the project, but prior to Final Completion of the work, the Contractor shall submit to the Owner three (3) copies of the updated O&M Manual to reflect the “as built” project for review by the Owner. After reviewing the manual for compliance with the specifications, the Owner’s comments will be returned with the Manuals to the Contractor for revision, if any.

D. The Contractor shall provide three (3) final copies of the manual and one (1) electronic copy of the manual.

1.3 BINDERS

A. All O&M information shall be bound in a binder with durable cleanable plastic covers. Each binder shall have:

1. 3-inch material capacity.
2. D-ring style.
3. 2 interior pockets.
4. Lever ring operators.
5. Clear vinyl extended view front and back pockets.
6. Vinyl cover shall be light grey or white.

B. Binder Cover and Spine

1. The cover of the binder shall include the following in order from top to bottom:

a. Project Name
b. "OPERATIONS AND MAINTENANCE MANUAL"
c. "VOLUME ____ OF ____ "
d. OWNER:

2. The Spine of the volume shall include the following in order from top to bottom:

a. Project Name
b. "OPERATIONS AND MAINTENANCE MANUAL"
c. "VOLUME ____ OF ____ "
d. OWNER:

1.4 TABLE OF CONTENTS

A. The table of contents shall be included in each volume. The table shall be neatly typewritten, arranged in a systematic order as follows:

1. Project Name

2. Year

3. Owner (name, address, and telephone number)

4. Engineer (name, address, and telephone number)

5. Contractor (name, address and telephone number)

6. List of each product or item included in each volume. The contents of all volumes shall be listed

B. The table shall provide a breakdown of the contents found in each volume.

1.5 DIVIDERS

A. All dividers shall be white and have standard three ring book punched holes with a reinforced binding edge. The divider tabs shall be integral to the divider with plastic coated colored tabs. Adhesive tabs will not be accepted. Each divider tab shall have the item description printed on the tab.

1.6 OPERATION AND MAINTENANCE MANUAL CONTENT FORMAT

A. General

1. Page Size: 8½ x 11 inch.

2. Paper: 20- pound minimum for typed pages,

3. Text: Type written, 10-point minimum point size or Manufacturer's printed data sheets,

4. Three hole punch all data for binding in three ring binders.

5. Provide fly-leaf for each separate product, or piece of operating equipment, with a description of the product and major component parts of the equipment, with typed description of the product and major component parts of equipment.

6. Each fly-leaf shall include the name, address, and telephone number of the subcontractor, supplier, or installer as appropriate and where possible the model or part number of the product.

B. Product Data and Information

1. Include only those sheets that are pertinent to the specific equipment, product, device or system.

2. Each sheet of the product data literature shall be clearly annotated with the product or part(s) installed, identification of subassemblies, drawings and appropriate descriptive narratives. The annotation type shall be consistent throughout the manual.

3. All references to non-applicable information shall be deleted or marked out to indicate the information is not applicable to the project.

4. All product information shall include: performance curves (where applicable), recommended spare parts, handling, storage, maintenance, operation, assembly, erection, installation, adjusting, emergency shutdown, troubleshooting, and as may be otherwise required.

5. All testing and certification information and requirements identified within these Contract Documents or as required by local, state or federal codes or laws.

6. Supplemental text shall be included for all product data where needed to further clarify any information or procedures.

7. Original manufacturer's literature shall be used in all instances where colored or black and white photos are a part of the product data literature or other information. Photocopying of original manufacturer's literature in all other instances will be acceptable provided the quality is equal to that of the original literature published by the manufacturer.

8. Electrical or electronic items or systems (supplemental information required to proceeding):

    a. Provide a description of the unit or component part which will include performance curves, engineering data, nameplate data, and test results (motor test data sheets, circuit tests, etc.).

    b. Interconnecting wiring diagrams, including all control and lighting systems.

    c. Listing of all panel board circuit directories.

    d. All manufacturer's printed operating and maintenance instructions for all electrical systems and components.

    e. List of recommended spare parts.

    f. Additional requirements for electrical equipment as defined in Division 26.

9. Materials and Finishes

    a. Manufacturer's data including catalog number, size, and composition.

    b. Color and texture designations.

    c. Care and maintenance instructions including cleaning agents and methods, cleaning precautions and recommended cleaning and maintenance schedules.

C. Drawings

1. Drawings shall be used to clearly illustrate product data information and other structural materials supplied on the project. Drawings shall be included with the product data sheets and O&M manual information when appropriate or in

individual sections if not applicable to other products. Drawings to be included shall:

a. Include individual product control, mechanical, and process flow diagrams for all products.

b. Be reduced to 8½ x 11 inches or 11 x 17 inches and folded to 8½ x 11 inches when practicable. Drawing title blocks shall be visible without unfolding the drawing. All drawings so reduced must in the opinion of the Owner be completely legible. Drawings deemed not to be legible shall be replaced with full size drawings by the Contractor.

c. Full size drawings shall be folded and placed in 8½ inch clear vinyl sheet protectors and bound in the manual with title blocks clearly displayed.

d. Drawings included with the manufacturer's literature shall be indexed by the manufacturer.

D. Electronic Format

1. The file and folder structure of the electronic copy of the O&M manual is to mirror the tabbed structure of the hardcopy.

2. Electronic documentation shall be provided on standard solid-state USB storage device media. All documents shall be provided in Adobe Systems portable document format (PDF), viewable with any commonly used PDF file reader, latest version. Where possible, the PDF documents shall be produced using a printer driver engine. Documents for which no electronic form exists may be scanned at 100 percent image scaling and a resolution of 300 dpi or better.

3. All PDF files shall be text captured, image with hidden text, optimized, searchable, and indexable using the Adobe Acrobat Catalog engine.

4. Drawings generated in AutoCAD shall be provided as both DWG files and PDF files.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 03 21 00

REINFORCING STEEL

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes all the work necessary to furnish, install and complete the reinforcing steel.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Submit shop drawings of detailed placing and bending lists for the Engineer's approval before the reinforcement is fabricated.

C. Mill Certificates: Mill test certificates shall be submitted to the Engineer to certify that the reinforcing steel meets the specified requirements. Mill test certificates shall be furnished and paid for by the Contractor.

1.3 QUALITY CONTROL

A. The Engineer may require that test samples be taken and test certificates be furnished by a reputable material testing laboratory at the Owner's expense.

PART 2 PRODUCTS

2.1 DEFORMED REINFORCING BARS

A. Unless otherwise specified, reinforcing steel shall be Grade 60 billet steel conforming to ASTM A615.

B. Varying grades shall not be used interchangeably in structures.

C. All such reinforcing shall be deformed steel bars with deformations conforming to the requirements set forth in ASTM Specification A615.

D. Steel bending processes shall conform to the requirements of ACI 318.

E. Bending or straightening shall be accomplished so that the steel will not be damaged.

F. Kinked bars shall not be used.

G. Spiral reinforcement and steel wire shall be cold-drawn steel wire conforming to the requirements of ASTM A82 unless shown otherwise on the Drawings.

2.2 PLAIN REINFORCING BARS

Spiral reinforcement shall be cold-drawn steel wire conforming to the requirements of ASTM A82 unless shown otherwise on the Drawings.

2.3 SUPPORTS

A. Bar supports shall conform to ACI 315.

B. Bar supports shall consist of approved high density "adobes", stainless steel chairs, plastic spacers or plastic shim plates.

1. Brick, broken concrete masonry units, spalls, rocks or similar materials shall not be used for support of reinforcing steel.

2. Steel chairs shall be furnished with plastic tips when incorporated into concrete exposed to view, such as in the roof slab.

3. Plastic spacers shall be PRECO BARSPAN WHEELS, as manufactured by the PRECO CORPORATION or equal.

4. Plastic shim plates may be used to support the plastic spacers and shall be used to support the vertical reinforcing in the corewall, unless shown otherwise on the Drawings.

C. Welded Wire Fabric Reinforcement

If specified on the Drawings, welded wire fabric shall be manufactured in accordance with ASTM A185. It shall be of new stock and free from rust when placed in the work.

D. Steel Tie Wire: Annealed steel tie wire shall be used to fasten the reinforcing steel in place.

PART 3 EXECUTION

3.1 REINFORCING BARS

Comply with the specified codes and standards and Concrete Reinforcing Steel Institutes recommended practice for "placing reinforcing bars," for details and methods of reinforcement placement and supports, and as herein specified.

A. General

1. Mild steel reinforcing bars shall be furnished, cut, bent and placed as indicated on the Drawings.

2. At the time of placing concrete, all reinforcement shall be free from loose mill scale, rust, grease or other coating which might destroy or reduce its bond with concrete.

3. Steel reinforcement which is to be placed in the work shall be stored under cover to prevent rusting, and shall be placed on blocking such that no steel touches any ground surface.

4. All reinforcing steel placed in the work shall be tied together and supported in such a manner that displacement during placing of concrete and shotcrete will not occur.

5. When there is a delay in depositing concrete, reinforcement shall be re-inspected and cleaned when necessary.

B. Cutting and Bending

1. Steel reinforcement shall be cut and bent in accordance with ACI 318 and with approved practices and machine methods, either at the shop or in the field.

2. Reinforcement shall be accurately formed to the dimensions indicated on the Drawings and on the bending schedule.

3. Bends for hooks on bars shall be made around a pin having a diameter not less than six times the minimum thickness of the bar.

4. All bars shall be bent cold.

C. Minimum Bar Spacing

The clear distance between parallel bars shall not be less than one and one-half times the diameter of the bars and, unless specifically authorized, shall in no case be less than one inch, nor less than the maximum size of coarse aggregate specified.

D. Concrete Cover (Minimum)

1. On all formed surfaces which will be exposed to water, ground or the elements, there shall be a nominal cover over the steel of 2 inches for bars number 6 through number 18 and 1.5 inches for bars number 5 and smaller, with an installation tolerance of + 1/4 inch. When crossing bars of different diameter are encountered in one face, one shall consider the bar size and location that will provide the largest cover over the nearest steel to the outside surface.

2. Unless otherwise specified in these specifications or shown on the Drawings, all reinforcing steel facing subgrades in footing and floors for concrete construction of the pump station shall be given a nominal protective cover of 3.0-inch minimum. The largest cover shall be used when different size bars are encountered in one face.

3. The minimum cover over reinforcing steel for concrete construction of other facilities shall be as shown on the Drawings.

4. No "bury" or "carrier" bars will be allowed unless specifically approved by the Engineer.

E. Splicing

1. Except as shown or specified on the Drawings, reinforcing steel shall not be spliced at any location without specific approval by the Engineer. Splices in adjacent bars shall be staggered.

2. Where permitted or required, splices in reinforcing steel shall have sufficient lap to transfer full strength of the bar by bond and shear. Unless specified or shown otherwise on the Drawings, the bars at a lap splice shall be in contact with each other. In no event shall the lap be less than 40 diameters of the spliced bars.

3. Unless specified or shown otherwise on the Drawings, bars shall be lap spliced in accordance with ACI 318 and shall be fastened together with steel tie wire.

4. Unless shown otherwise on the Drawings, where bars are to be lapped spliced at joints in the concrete, all bars shall project from the concrete first placed, a minimum length equal to the lap splice length indicated on the Drawings. All concrete or other deleterious coating shall be removed from dowels and other projecting bars by wire brushing or sandblasting before the bars are embedded in a subsequent concrete placement.

F. Supports

1. All reinforcement shall be retained in place, true to indicated lines and grades, by the use of approved bar supports. The Contractor shall submit for Engineer's approval, samples of all bar supports he proposes to use along with a written description of where each bar support will be used.

2. The supports shall be of sufficient quantity, strength and stability to maintain the reinforcement in place throughout the concreting operations. Bar supports shall be placed no further than 4 feet apart in each direction. Supports must be completely concealed in the concrete and shall not discolor or otherwise mar the surface of the concrete. The Contractor shall be held responsible for providing the appropriate quantity and type of bar supports.

3. Do not place reinforcing bars more than two inches beyond the last leg on continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

G. Bar Tying

1. Bars shall be tied sufficiently often to prevent shifting. There shall be at least three ties in each bar length (this shall not apply to dowel laps or to bars shorter than 4 feet, unless necessary for rigidity).

2. Slab bars shall be tied at every intersection around the periphery of the slab. Wall bars and slab bar intersections shall be tied at not less than every fourth intersection, but at not greater than the following maximum spacings:

	Slab Bars (inches)	Wall Bars (inches)
Bars No. 5 and smaller	60	48
Bars No. 6 through No. 9	96	60
Bars No. 10 through No. 11	120	96

H. Reinforcement Around Openings -- Where reinforcing steel has to be cut to permit passage of pipe or to create openings, and should no detail be shown for extra reinforcing in such areas, the area of steel removed by the creation of the opening must be replaced by placing at least double the area of steel removed by the opening equally around the openings. The steel shall be placed such that it extends 5 feet beyond the opening on each side to provide for sufficient bond.

3.2 WELDED WIRE FABRIC REINFORCEMENT

A. General

1. All necessary tie wiring, spacing chairs, or supports shall be installed to keep the welded wire fabric in place while concrete is being placed.

2. The welded wire fabric shall be bent as shown or required on the Drawings to fit the work. Welded wire fabric shall be rolled or otherwise straightened to make a perfectly flat sheet before placing in the Work.

B. Splicing

1. Welded wire fabric shall be lap spliced as indicated on the Drawings. If the lap splice length is not indicated on the Drawings, the welded wire fabric shall be spliced in accordance with ACI 318 and no less than a minimum of 40 wire diameters of the lapped wire, or 12 inches, whichever is greater.

2. Offset end laps in adjacent widths to prevent continuous laps in either direction.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. The extent of concrete work is shown on the Drawings.

B. Work includes providing formwork and shoring for cast-in-place concrete and installation into formwork of items such as reinforcing steel bar (rebar), anchor bolts, setting plates, bearing plates, anchorages, inserts, reveals, frames, nosings, sleeves and other items to be embedded in concrete.

1.2 QUALITY ASSURANCE

A. Codes and Standards

Comply with the provisions of the following codes, specifications and standards, except as otherwise shown or specified here:

ACI 301 "Specifications for Structural Concrete for Buildings"

ACI 311 "Recommended Practice for Concrete Inspection"

ACI 318 "Building Code Requirements for Reinforced Concrete"

ACI 347 "Recommended Practice for Concrete Formwork"

ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete"

Concrete Reinforcing Steel Institute, "Manual of Standard Practice"

Comply with building code requirements which are more stringent than the above and all OSHA requirements.

B. American Society for Testing and Materials (ASTM)

1. C31, Making and Curing Concrete Test Specimens in the Field.

2. C33, Specification for Concrete Aggregate.

3. C39, Compressive Strength of Cylindrical Concrete Specimens.

4. C40, Organic Impurities in Fine Aggregate for Concrete.

5. C85, Cement Content of Hardened Portland Cement Concrete.

6. C88, Soundness of Aggregates by use of Sodium Sulfate or Magnesium Sulfate.

7. C94, Standard Specifications for Ready-Mixed Concrete.

8. C131, Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

9. C136, Method for Sieve Analysis to Fine and Coarse Aggregate.

10. C143, Slump of Portland Cement Concrete.

11. C150, Standard Specification for Portland Cement.

12. C156, Water Retention by Concrete Curing Materials.

13. C173, Air Content of Freshly Mixed Concrete by the Volumetric Method.

14. C231, Air Content of Freshly Mixed Concrete by the Pressure Method.

15. C233, Standard Method of Testing Air-Entraining Admixtures for Concrete.

16. C260, Standard Specifications for Air-Entraining Admixtures for Concrete.

17. C289, Standard Test Method for Potential Reactivity of Aggregates (Chemical Method).

18. C441, Standard Test Method for Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to the Alkali-Aggregate Reaction.

19. C457, Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete.

20. C494, Standard Specifications for Chemical Admixtures for Concrete.

21. C670, Preparing Precision Statements for Test Methods for Construction Materials.

22. C803, Penetration Resistance of Hardened Concrete.

C. Workmanship

The Contractor is responsible for correction of concrete work that does not conform to the specified requirements, including strength, tolerances and finishes. Correct deficient concrete as directed by the Engineer. Contractor shall also be responsible for

the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

D. Concrete Testing Service

The Owner or a representative of the Owner will engage a special inspector/testing laboratory to perform material evaluation tests and to design concrete mixes. See detailed requirements in Part 3.14 "Quality Control Testing during Construction". Per the Owner or Engineer's requirements the Contractor shall notify the designated representative to schedule the special inspections and materials testing required by the project documents.

E. Testing Requirements

Materials and installed work may require testing and retesting, as directed by the Engineer, at anytime during the progress of the work. Allow free access to material stockpiles and facilities at all times. All testing, including the retesting of rejected materials and installed work shall be done at the Contractor's expense.

F. Tests for Concrete Materials

1. Test aggregates by the methods of sampling and testing of ASTM C33.

2. For Portland cement, sample the cement and determine the properties by the methods of test of ASTM C150.

3. Submit written reports to the Engineer, for each material sampled and tested prior to the start of work. Provide the project identification name and number, date of report, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer and brand name for manufactured materials, values specified in the referenced specification for each material, and test results. Indicate whether or not material is acceptable for intended use.

4. Certificates of material properties and compliance with specified requirements may be submitted in lieu of testing. The materials producer and the Contractor must sign certificates of compliance.

G. Allowable Tolerances:

1. Construct formwork to provide completed cast-in-place concrete surfaces complying with the tolerances specified in ACI 347, and as follows:

   a. Variation from plumb in lines and surfaces of walls; 1/4-inch per 10 feet, but not more than 1-inch. For exposed control joint grooves and other conspicuous lines, 1/4-inch in any bay or 20 feet maximum; 1/2-inch maximum in 40 feet or more.

b. Variation from position of the linear lines and walls 1/2-inch in any bay or 20 feet maximum, and 1-inch in 40 feet or more.

c. Variation in sizes and locations of sleeves, floor openings, and wall openings, 1/4-inch.

2. Before concrete placement check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.

3. During concrete placement check formwork and related supports to ensure that forms are not displaced, and that completed work will be within specified tolerances.

H. Quality Control Testing During Construction

See Section 3 - Execution.

1.3 SUBMITTALS

A. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with the ACE 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures" showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangements of concrete reinforcement. Include special reinforcement required at openings through concrete structures.

B. Submit copies of laboratory test reports for concrete materials and mix design tests as specified.

C. Material Certificates may be provided in lieu of materials laboratory test reports. The material manufacturer and the Contractor, certifying that each material item complies with, or exceeds, the specified requirements shall sign material certificates.

1.4 CONCRETE MIX DESIGNS

A. All concrete materials shall be proportioned so as to produce a workable mixture in which the water content will not exceed the maximum specified.

B. If the concrete mix designs specified herein have not been used previously by the ready-mix supplier or if directed by the Engineer, mix proportions and concrete strength curves for regular cylinder tests, based on the relationship of 7, 14 and 28 day strengths versus slump values of two (2), four (4), and six (6) inches, all conforming to these Specifications, shall be established by an approved ready-mix supplier or an independent testing laboratory. A laboratory, independent of the ready-mix supplier, shall be required to prepare and test all concrete cylinders. The costs for preparation of mix designs (if required by the Owner to be performed by an independent testing

laboratory) and testing of concrete and materials shall be borne by the Owner, except when materials do not meet specified requirements, in which case such costs shall be borne by the Contractor.

C. The exact proportions by weight of all materials entering into the concrete delivered to the jobsite shall conform to the approved mix design unless specifically so directed by the Engineer or Laboratory for improved specified strength or desired density, uniformity and workability.

D. The proportions of such mix design shall be based on a full cubic yard of hardened concrete.

E. Ready-mix companies or jobsite batch plants shall furnish delivery tickets, signed by a Certified Weighmaster, on which each shall state the weight of aggregates, sand, cement, admixtures and water and the number of cubic yards of concrete furnished, which will be compared against the approved mix design.

F. There shall be no variation in the weights and proportions of materials from the approved mix design.

G. There shall be no variation in the quality and source of materials once they have been approved for the specific mix design.

1.5 READY-MIXED CONCRETE

Ready-mixed concrete shall conform to the requirements of ACI 301 and ASTM C 94. In case of conflict, ACI 301 shall govern.

PART 2 PRODUCTS

2.1 FORM MATERIALS

A. Form Coatings

Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion, nor impede wetting of surfaces to be cured with water or curing compound. Petroleum based coatings shall not be used for structures in creeks and waterways. Biodegradable coatings shall be used which will not contaminate the creeks/waterways or an alternate method for stripping the form shall be proposed.

B. Inserts

Provide metal inserts for anchorage of materials or equipment to concrete construction, not supplied by other trades and as required for the work. Provide “Parabolt” by the Molly Company, “Phillips Red-Head”, or “Burke” products. The Contractor is responsible for insuring that all required anchorage not specified in the project documents is installed per current building code and applicable ICC report requirements.

2.2 REINFORCING MATERIALS

A. Reinforcing Bar (rebar): ASTM A615 and as follows below>

Stirrups and Ties	Grade 60 (Grade 40 may be used for #3 and smaller)
All other Uses	Grade 60

B. Steel Wire: ASTM A82, plain, cold-drawn, steel.

C. Welded Wire Fabric (WWF): ASTM A185, welded steel wire fabric.

D. Supports for Reinforcement

Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations, unless otherwise specified. Wood, brick, concrete blocks and other devices will not be acceptable. For slabs-on-grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs that are hot-dip galvanized, after fabrication, or plastic protected or stainless steel protected.

2.3 CONCRETE MATERIALS

A. Portland Cement

ASTM C150, Type II, unless otherwise acceptable to Engineer. Use only one (1) brand of cement throughout the project, unless otherwise acceptable to the Engineer. The use of ground granulated blast furnace slag is not allowed.

B. Aggregates

ASTM C33 and as herein specified. Provide aggregates from a single source for all exposed concrete.

Local aggregates not complying with ASTM C33 but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to the Engineer.

1. Fine Aggregate - Clean, sharp, natural sand free from loam, clay, lumps or other deleterious substances. Dune sand, bank-run sand and manufactured sand are not acceptable.

2. Coarse Aggregate - Clean, uncoated, processed aggregate containing no clay, mud, loam or foreign matter, as follows:

    a. Crushed stone processed from natural rock or stone.

    b. Washed gravel, either natural or crushed. Use of pit or bank run gravel is not permitted.

    c. Maximum Aggregate Size - Not larger than one-fifth (1/5) of the narrowest dimensions between sides of forms, one-third (1/3) of the depth of slabs, nor three-fourths (3/4) of the minimum clear space between individual reinforcing bars or bundles of bars.

3. These limitations may be waived if, in the judgment of the Engineer, workability and methods of consolidation are such that concrete can be placed without honeycomb or voids.

4. In general it is desired that normal commercial mixes using 1-1/2-inch or 3/4-inch maximum aggregate size be used.

5. Aggregate for exposed aggregate concrete shall consist of selected aggregate of washed clean river gravel in color range of medium to dark in browns and grays; material uniformly sized 5/8-inch to 3/4-inch.

C. Water: Clean, fresh, drinkable.

D. Air Entraining Admixture: ASTM C260.

E. Water-Reducing Admixture: ASTM C494, Type A.

F. Set-Control Admixtures: ASTM C494, as follows:

1. Type B, Retarding.
2. Type C, Accelerating.
3. Type D, Water-reducing and Retarding.
4. Type E, Water-reducing and Accelerating.

Calcium chloride will not be permitted in concrete, unless otherwise authorized in writing by the Engineer.

2.4 RELATED MATERIALS

A. Bituminous and Fiber Joint Filler

Provide resilient and non-extruding type premolded bituminous impregnated fiberboard units complying with ASTM D1751, FS HH-F-341, Type 1 and AASHTO M 213. Provide one of the following products:

1. Elastite; Philip Carey/Celotex
2. Flexcell; Celotex Corp.
3. Crane Fiber 1390; W.R. Grace & Co.
4. Fibre; W.R. Meadows, Inc.
5. Tex-Lite; J & P Petroleum Prod. Inc.
6. Sonoflex; Sonneborn/Contech, Inc.

B. Form Ties (for forms other than wall forms)

Factory-fabricated, adjustable-length, removable or snapoff metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Unless otherwise shown, provide ties so portion remaining within concrete after removal is at least 1-1/2 inches inside concrete. Unless otherwise shown, provide form ties, which will not leave holes larger than 1-inch in diameter in concrete surface.

C. Concrete Curing Materials

Acrylic curing and sealing compound - Water emulsion acrylic curing and sealing compound formulated of acrylic polymers of water-based carrier. W.R. Meadows, Inc. VOCOMP-20 or approved equal.

D. Non-slip Aggregate Finish

Provide fused aluminum oxide grits, or crushed emery, as abrasive aggregate for non-slip finish with emery aggregate containing not less than 40 percent aluminum oxide and not less than 25 percent ferric oxide. Use material that is factory-graded, packaged, rustproof and non-glazing, and is unaffected by freezing, moisture and cleaning materials.

E. Non-shrink Grout: See Section 03 60 00, Grouting.

2.5 PROPORTIONING NORMAL CONCRETE

A. Proportion mixes by either laboratory trial batch or field experience methods, using materials to be employed on the project for each class of concrete required, complying

with ACI 211.1. All measurements shall be by weight. All concrete admixtures will either be by the same supplier to insure compatibility. If different suppliers are used a memorandum from EACH admixture supplier will be provided stating the compatibility of their product with the other supplier's products.

B. The slump shall be between two inches and four inches when tested in accordance with ASTM Specifications C 143. Variations in the slump range may be allowed by the Engineer if admixtures, such as water reducers or superplasticizers, are utilized in the concrete mix. Regardless of the measured slump, the maximum allowable water-cement ratios as specified here-in, shall be strictly adhered to.

C. Compressive Strength, Water and Cement Content

Notwithstanding what has been stated here-before, and unless shown otherwise on the Drawings, the concrete shall meet the following requirements. All concrete except as noted otherwise on the drawings shall have 4,500 psi 28-day compressive strength. The maximum water content per 94-pound sack of cement is 4.5 gallons. The minimum cement content for the 4,500psi mix is 6.0 sacks (94-pound sack of cement per cubic yard of concrete). Up to a maximum of 15% of cementitious material may be fly ash in accordance with ASTM C618. The use ground granulated blast furnace slag is not allowed.

D. Retarding Densifiers

1. All concrete (as defined in 2.9 below) used for wall construction shall also contain DARATARD-17, as manufactured by Grace Const. Products, Cambridge, MA or MBL-82, as manufactured by Master Builders, Cleveland, OH in the amounts recommended by the additive manufacturer whenever the air temperature during the pour exceeds 85° F.

2. To be considered as equal, any alternate product offered for consideration shall contain no calcium chloride, and shall be compatible with air-entrained cements and air-entraining admixtures conforming to the applicable ASTM, AASHTO, ANSI and Federal specifications.

3. Contractor shall certify that admixtures do not contain calcium chlorides or other corrosive materials.

E. Air-Entraining Agents

1. All concrete that that is specified to be air entrained or that may be exposed to freeze/thaw action either during construction or the service life of the structure must be air entrained. Sufficient air-entraining agent shall be used to provide total air content of 5 percent, +/- 1 percent.

2. Air-entraining agents shall meet ASTM C 260, ASTM C 233 and ASTM C 457.

3. The maximum total volumetric air content of the concrete before placement shall be six (6) percent plus or minus one percent as determined by ASTM C 173 or ASTM 231.

4. Subject to these Specifications, consideration will be given to the following products: PROTEX "AES," GRACE "DAREX AEA," MASTER BUILDERS "MB-AE10," or SIKA CHEMICAL "AER."

F. Water Reducing Admixtures

1. In addition to air-entrainment, approved water reducing additives, which do not affect the ultimate performance of any steel in any way, may be added to maintain the maximum water content below that specified herein. Water reducing additives shall conform to ASTM C 494, Type A or D.

2. The use of water reducing additives shall not permit a reduction in the minimum specified cement content or in the specified amount of air-entrainment.

3. Admixtures shall contain no calcium chloride, tri-ethanolamine or fly ash. All admixtures shall be from the same manufacturer.

4. Superplasticizers, if allowed by the Engineer, shall conform to ASTM C 494, Type F or G, batch plant added using second or third generation only.

5. Set control admixtures if allowed by the Engineer, shall conform to ASTM C 494, Type B (retarding) or Type C (accelerating).

G. Fiber reinforcement admixture shall be included in the ready-mix concrete design used for filling and channeling the wet well chambers. Fibers shall be used in strict accordance with the manufacturer's directions.

2.6 CONCRETE MIXING

Ready-Mix Concrete - Comply with the requirements of ASTM C94, and as herein specified. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required. When the air temperature is between 85°F and 90°F, reduce the mixing and delivery time from 1-1/2 hours to 75 minutes, and when the air temperature is above 90°F, reduce the mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 FORMS

A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formworks so concrete members and structures are of correct size, shape, alignment, elevation and position.

B. Design formworks to be readily removable without impact shock, or damage to cast-in-place concrete surfaces and adjacent materials.

C. Construct forms complying with ACI 347, to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

D. Fabricate forms for easy removal without hammering or prying against the concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

E. Erect falsework and support; brace and maintain it to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place concrete structures.

Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.

Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances.

F. Forms for Exposed Concrete

Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes. Do not use metal cover plates for patching holes or defects in forms. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections. Use extra studs, walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete.

Do not use narrow strips of form material, which will produce bow. Assemble forms so they may be readily removed without damage to exposed concrete surfaces. Form molding shapes, recesses and projections with smooth-finish materials, and install in forms with sealed joints to prevent displacement.

G. Cleaning and Tightening - Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms after concrete placement if required to eliminate mortar leaks.

3.2 PLACING REINFORCEMENT

Detail and place according to ACI Manual SP-66. Unless otherwise noted, minimum cover shall be 1-1/2 inches for No. 5 and smaller bars, two (2) inches for No. 6 and larger bars and three (3) inches when poured against earth. Unless otherwise noted, bend all horizontals reinforcing a minimum of two (2) feet at corners and wall intersections.

A. Clean reinforcement of loose rust and mill scale, earth, ice and other materials which reduce or destroy bond with concrete.

B. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.

C. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces. Do not place reinforcing bars more than two inches beyond the last leg of continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

D. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh plus two (2) inches, and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.3 JOINTS

A. Construction Joints - Locate and install construction joints, which are not shown on the drawings, so as not to impair the strength and appearance of the structure, as acceptable to the Engineer.

B. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints. Unless otherwise specified, reinforcement shall be lapped in accordance with ACI Standards.

C. Control Joints in Slabs-on-Ground - Construct control joints in slabs-on-ground to form panels of patterns as shown. Use inserts 1/4-inch wide by one-fifth (1/5) to one-fourth (1/4) of the slab depth, unless otherwise shown.

1. Form control joints by inserting a premolded hardboard or fiberboard strip into the fresh concrete until the top surface of the strip is flush with the slab surface. After the concrete has cured, remove inserts and clean groove of loose debris.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. General - Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs - Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screed strips by the use of strike-off templates or accepted compacting type screeds.

C. Cast in Place Reglets - Place in straight and continuous lines as detailed to enable flashing to be applied continuously without deviation at reglet joints more than 1/8-inch. Miter corners for continuous reglet joint where outside corners occur. At inside corners extend one section 1-inch past corner. Adequately anchor or secure reglets per manufacturer's instructions prior to pouring and during construction to insure dimensional tolerances and alignment. Vibrate concrete to insure concrete cover adjacent to and around reglet. Visually inspect after pour and patch as required.

3.5 PREPARATION OF FORM SURFACES

Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed. Thin formcoating compounds only with thinning agent of type, and in amount, and under conditions of the form-coating compound manufacturer's directions. Use dissipating-type form oil at surfaces to receive cement plaster finish. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.6 CONCRETE PLACEMENT

A. Pre-Placement Inspection

1. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts involved in ample time to permit the installation of their work; cooperate with other trades

in setting such work as required. Notify Engineer in time for inspection prior to pouring.

2. Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used.

3. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

4. Concrete Curbs and Paving - Do not place concrete until subbase is completed and approved by the Engineer as required to provide uniform dampened condition at the time concrete is placed. Moisten subbase as required to provide uniform dampened condition at the time concrete is placed.

B. Place concrete in compliance with the practices and recommendations of ACI 304 and as herein specified.

1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete, which is being integrated, with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure, which will cause segregation.

2. Screed concrete which is to receive other construction to the proper level to avoid excessive skimming or grouting.

3. Do not use concrete which becomes non-plastic and unworkable or does not meet the required quality control limits or which has been contaminated by foreign materials. Do not use retempered concrete. Remove rejected concrete from the project site and dispose of in an acceptable location. Do not use concrete whose allowable mixing time has been exceeded.

C. Concrete Conveying

1. Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practicable by methods, which will prevent segregation and loss of concrete mix materials.

2. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice and other deleterious materials.

3. The Contractor shall provide traffic control on the narrow access roads to the work sites.

4. The Contractor shall not wash concrete trucks/chutes/equipment off at the project site unless plastic tarps and hay bales are employed to contain the concrete. The Contractor will be required to haul off-site all concrete contaminated soil.

D. Placing Concrete into Forms

1. Do not interrupt successive placement; do not permit cold joints to occur.

2. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.

3. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding or tamping. Use equipment and procedures for consolidation of concrete in accordance with the recommended practices of ACI 309, to suit the type of concrete and project conditions. Vibration of forms and reinforcing will not be permitted.

4. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete at least six (6) inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.

E. Placing Concrete Slabs

1. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.

2. Consolidate concrete during placing operations using mechanical vibrating equipment so the concrete is thoroughly worked around reinforcement and other embedded items and into corners.

3. Bring slab surfaces to the correct level with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

4. Maintain reinforcing steel in the proper position continuously during concrete placement operations.

F. Cold Weather Placing

1. Protect all concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306 and as herein specified.

2. When the air temperature has fallen to or is expected to fall below 40°F, provide adequate means to maintain the temperature in the area where concrete is being placed at either 70°F for three (3) days or 50°F for five (5) days after placing. Provide temporary housing or coverings including tarpaulins or plastic film. Keep protections in place and intact at least 24 hours after artificial heat is discontinued. Keep concrete moist. Avoid rapid dry-out of concrete due to over-heating and avoid thermal shock due to sudden cooling or heating.

3. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50°F, and not more than 80°F, at point of placement.

4. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms, reinforcing steel and adjacent concrete surfaces are entirely free of frost, snow and ice before placing concrete.

5. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators unless otherwise accepted in mix designs.

G. Hot Weather Placing

1. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

2. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.

3. Cover reinforcing steel with water soaked burlap if it becomes too hot so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

4. Wet forms thoroughly before placing concrete.

5. Do not use retarding admixtures unless otherwise accepted in mix designs.

3.7 FINISH OF FORMED SURFACES

A. Rough Form Finish

For formed concrete surfaces not exposed to view in the finish work or covered by other construction, unless otherwise shown or specified. This is the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4-inch in height rubbed down or chipped off.

B. Smooth Form Finish

Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view. Or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete such as waterproofing, damp proofing, painting or other similar system.

Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrically with a minimum of seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed.

C. Curb Finishes

Curbs shall be screeded off accurately to true lines and planes or warped surfaces as indicated or directed. Finish smooth. Arises shall be true and straight or properly eased where curved and neatly rounded with approved tool. Smooth trowel finish with corners rounded to 3/4-inch radius.

D. Grout Cleaned Finish (Sacked)

Provide grout cleaned finish to scheduled concrete surfaces which have received smooth form finish treatment, and to all exposed to view interior and exterior building surfaces, typical.

Combine one part Portland cement to 1-1/2 parts fine sand by volume, and mix with water to the consistency of thick paint. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.

Thoroughly wet concrete surfaces and apply grout immediately to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.

E. Related Unformed Surfaces

At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

3.8 MONOLITHIC SLAB FINISHES

A. Float Finish

1. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing or sand bed terrazzo, and as otherwise shown on drawings or in schedules.

2. After placing concrete slabs, do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of a power-driven float, or both. Consolidate the surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Check and level the surface plane to a tolerance not exceeding 1/4-inch in 10 feet when tested with a 10-foot straightedge placed on the surface at not less than two different angles. Cut down high spots and fill at low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture.

B. Trowel Finish

1. Apply trowel finish to monolithic slab surfaces that are to be exposed to view, unless otherwise shown, and slab surfaces that are to be covered with resilient flooring, paint, or other thin-film finish coating system.

2. After floating, begin the first trowel finish operation using a power-driven trowel. Begin final troweling when the surface produces a ringing sound as the trowel is moved over the surface.

3. Consolidate the concrete surface by the final hand troweling operation, free of trowel marks, uniform in texture and appearance, and with a surface plane tolerance not exceeding 1/8-inch in 10 feet when tested with a 10-foot straightedge. Grind smooth surface defects which would telegraph through applied floor covering system.

C. Broom Finish (Non-Slip)

1. Apply non-slip, broom finish to exterior concrete walkways, platforms, steps and ramps and elsewhere as shown on the drawings or in schedules.

2. Immediately after trowel finish, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route or in the direction of water flow. Use fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the Engineer before application.

3.9 SCHEDULE OF CONCRETE SURFACE FINISHES

Also see Section 09 90 00, Painting and Coating for protective coating requirements.

Surface Description	Type	Finish Requirement
Exterior Horizontal Slabs	Slab	Broom Finish (Non-Slip)

3.10 CONCRETE CURING AND PROTECTION

A. General

1. Protect freshly placed concrete from premature drying and excessive cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

2. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 72 hours.

3. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least seven (7) days and in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

B. Curing Methods

Perform curing of concrete by moist curing, by moisture-retaining cover curing, by membrane curing or by combinations thereof, as herein specified. Provide the curing methods indicated as follows:

1. For concrete floor slabs provide moisture curing, moisture cover curing or liquid membrane/chemical curing-hardening curing. If liquid membrane curing is used, it must be compatible with concrete hardening compounds to be applied later.

2. For other concrete work, provide moisture curing or moisture cover curing. Do not use liquid membrane or chemical curing-hardening curing on any concrete work to receive any applied finishes.

3. For curing, use only water that is free of impurities, which could etch or discolor exposed, natural concrete surfaces.

4. Provide moisture curing by any of the following methods:

    a. Keeping the surface of the concrete continuously wet by covering with water.

    b. Continuous water-fog spray.

    c. Covering the concrete surface with the specified absorptive cover thoroughly saturated with water and keeping the absorptive cover continuously wet. Place absorptive cover so as to provide coverage of the concrete surfaces and edges with a 4-inch lap over adjacent absorptive covers.

5. Provide moisture-cover curing as follows - Cover the concrete surfaces with the specified moisture-retaining cover for curing concrete placed in the widest practicable width with sides and ends lapped at least three (3) inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

6. Curing Unformed Surfaces

    a. Initially cure unformed surfaces, such as slabs, floor topping and other flat surfaces by moist curing, whenever possible.

    b. Final cure unformed surfaces, unless otherwise specified, by any of the methods specified above, as applicable.

    c. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise acceptable to the Engineer.

C. Temperature of Concrete during Curing

1. When the atmospheric temperature is 40°F and below, maintain the concrete temperature between 50°F and 70°F continuously throughout the curing period. When necessary, make arrangements before concrete placing for heating, covering, insulation or housing as required to maintain the specified temperature and moisture conditions continuously for the concrete curing period. Provide cold weather protections complying with the requirements of ACI 306.

2. When the atmospheric temperature is 80°F, and above, or during other climatic conditions which will cause too rapid drying of the concrete, make arrangements before the start of concrete placing for the installation wind breaks or shading, and for fog spraying, wet sprinkling or moisture-retaining covering. Protect the

concrete continuously for the concrete curing period. Provide hot weather protections complying with the requirements of ACI 305.

3. Maintain concrete temperature as uniformly as possible and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete, which exceed 5°F in any one-hour and 50°F in any 24-hour period.

D. Protection from Mechanical Injury - During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations.

3.11 MISCELLANEOUS CONCRETE ITEMS

A. Filling-In - Fill-in holes and openings in concrete structures for the passage of work by other trades, unless otherwise shown or directed, after the work of other trades is in place. Mix, place and cure concrete as herein specified, to blend with in-place construction. Provide all other miscellaneous concrete filling shown or required to complete the work.

B. Curbs - Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations - Provide machine and equipment bases and foundations as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment.

3.12 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas

1. Repair and patch defective areas with cement mortar immediately after removal of forms but only when directed by the Engineer.

2. Cut out honeycomb, rock pockets, voids over 1/2-inch diameter and holes left by tie rods and bolts down to solid concrete but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the Engineer.

3. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, the patching mortar will match the color of the surrounding concrete. Provide test areas at inconspicuous location to verify

mixture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

4. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure complete filling.

3.13 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. The Owner or a representative of the Owner will engage a special inspector/testing laboratory to perform all tests and to submit test reports to the Engineer and the Contractor.

B. Concrete shall be sampled and tested for quality control during the placement of concrete, as follows:

1. Sampling Fresh Concrete - ASTM C172, except modified for slump to comply with ASTM C94.

2. Slump - ASTM 143; one (1) test for each concrete load at point of discharge; and one (1) for each set of compressive strength test specimens.

3. Air Content - ASTM C231, pressure method; one (1) for each set of compressive strength test specimens.

4. Compression Test Specimen - ASTM C31; one (1) set of four (4) standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

5. Concrete Temperature - Test hourly when air temperature is 40°F and below, and when 80°F and above; and each time a set of compression test specimens is made.

6. Compressive Strength Tests - ASTM C39; one (1) set for each 100 cubic yards or fraction thereof, of each concrete class placed in any one (1) day or for each 5,000 square feet of surface area placed; one (1) specimen tested at seven (7) days, two (2) specimens tested at 28 days, and one (1) specimen retained in reserve for later testing if required.

   a. When the frequency of testing will provide less than five (5) strength tests for a given class of concrete, conduct testing from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.

   b. When the total quantity of a given class of concrete is less than 50 cubic yards, the strength tests may be waived by the Engineer if, in his judgment, adequate evidence of satisfactory strength is provided.

C. Report test results in writing to the Engineer and the Contractor on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of Contractor, name of concrete supplier and truck number, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength and type of break for both 7-day tests and 28-day tests.

D. Additional tests - The testing service will make additional tests of in-place concrete when test results indicate the specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Engineer. The testing service shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION

SECTION 03 60 00

GROUTING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes all work necessary to form, mix, place, cure, repair, finish, and do all other work as required to produce finished grout, in accordance with the requirements of the Contract Documents.

B. Work covered in this Section includes:

1. Grouting.
2. Removal of loose and spalling grout and concrete.
3. Anchoring, patching, grouting, and sealing.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Specifications, codes, and standards shall be as specified in Section 03 30 00, Cast-in-Place Concrete and as referred to herein.

B. Commercial Standards:

1. CRD-C 621, Corps of Engineer's Specification for Non-Shrink Grout

2. ASTM C109, "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch or 50-mm Cube Specimens)"

3. ASTM C531, "Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes"

4. ASTM C579, "Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes"

5. ASTM C827, "Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures"

1.3 SUBMITTALS

A. Manufacturer's Literature: Containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of non-shrink and epoxy grout used in the work.

PART 2 PRODUCTS

2.1 PREPACKAGED GROUTS

A. Non-shrink grout: This type of grout is to be used wherever grout is required in the Contract Documents, unless another type is specifically referenced.

B. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation of each class of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.

C. Class A non-shrink grouts shall have minimum 28 day compressive strength of 5000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRDC 621.

D. Class B non-shrink grouts shall have minimum 28 day compressive strength of 5000 psi and shall meet the requirements of CRD C621.

E. Application

1. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is specified in the contract documents; except, for those applications for Class B non-shrink grout specified herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.

2. Class B non-shrink grout shall be used or the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

2.2 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is 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 specified herein for the particular application.

B. The slump for topping grout and concrete fill shall be adjusted to match placement and finishing conditions but shall not exceed four (4) inches.

2.3 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers approved by the Engineer. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

A. All surface preparation, curing, and protection of cement grout shall be as specified by the manufacturer. The finish of the grout surface shall match that of the adjacent concrete.

B. The manufacturer of Class A non-shrink grout shall provide on-site technical assistance upon request.

C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the Engineer.

3.2 GROUTING PROCEDURES

Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution of prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. The extent of metal fabrications work is shown on the Drawings and includes items fabricated from iron, steel, stainless steel and aluminum shapes, plates, bars, sheets, strips, tubes, pipes and castings which are not a part of structural steel or other metal systems in other sections of these specifications.

B. Section Includes:

1. Shop-fabricated metal items
2. Anchor bolts
3. Access hatches
4. Fasteners

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Manufacturer's Data: For information only, submit copies of manufacturer's specifications, load tables, dimension diagrams, anchor details and installation instructions for products to be used in miscellaneous metal work, including paint products.

C. Shop Drawings:

1. General: Submit copies of shop drawings for the fabrication and erection of all assemblies of miscellaneous metal work which are not completely shown by the manufacturer's data sheets.

    a. Include plans, elevations and details of sections and connections and fabricators proposed shop coat paint or galvanizing specifications.

    b. Show anchorage and accessory items.

    c. Furnish setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete construction.

    d. Indicate welded connections using standard AWS A2.4 welding symbols.

e. Indicate net weld lengths.

D. Samples:

1. Submit two sets of representative samples of materials, illustrating factory finishes as may be requested by the Engineer.

2. Engineer's review will be for color, texture, style and finish only.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

F. Delegated Design Submittals:

1. Submit signed and sealed Shop Drawings from a registered, licensed professional engineer within the State of Washington.

G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

H. Qualifications Statement:

1. Submit qualifications for licensed professional to perform Delegated Design Submittals as noted above.

1.3 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 66 00

PART 2 PRODUCTS

2.1 GENERAL

A. For the fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, roughness and defects which impair strength, durability and appearance. Remove such blemishes by grinding or by welding and grinding prior to cleaning, treating and application of surface finishes including zinc coatings.

2.2 ANCHORS

A. All anchors shall be epoxy anchors or expansion anchors as shown in the Drawings.

B. Materials:

1. As shown in the Drawings.

2. For direct bury:

    a. Malleable iron complying with ASTM A47.
    b. Cast steel complying with ASTM A27.
    c. Iron and steel galvanized in compliance with ASTM A153.

3. For other conditions

    a. Type 316 stainless steel.

4. Threaded rod, nuts, bolts and washers:

    a. Material matching anchor insert type.

C. Types:

1. Threaded-type Concrete Inserts:

    a. Internally threaded to receive machine bolts.
    b. Malleable iron, ASTM A47.
    c. Cast steel, ASTM A27.
    d. Stainless steel, type 304, ASTM A320.

2. Wedge-type Concrete Inserts:

    a. Box-type ferrous castings, designed to accept bolts having special wedge-shaped heads.

3. Slotted-type Concrete Inserts:

    a. Box-type welded construction with slot designed to receive square head bolt and with knockout cover.

D. Manufacturers:

1. Hilti, Inc.
2. Simpson Strong-Tie Co., Inc.
3. Proprietary products as named in the Drawings.

2.3 ACCESS HATCHES

A. Use materials of the size and thickness shown in Drawings or, if not shown in the Drawings, of the size recommended by product manufacturer.

B. Work to the dimension shown in the Drawings or accepted on final shop drawings, using proven details of fabrication and support.

C. Use the type of materials shown or specified for the various components of the Work.

D. Components/Description:

1. Flush grip handle.
2. Stainless steel spring lifting mechanism assembly.
3. Heavy duty automatic lock open arm with red vinyl release grip.
4. Rated for H-20 loading
5. 1-1/2” drain coupling.
6. Channel frame with anchor flange.
7. Shop finish of cover and frame: WSDOT approved non slip surfacing
8. Recessed hasp for pad lock.
9. Aluminum in contact with concrete or grout shall be coated with epoxy as specified herein.

E. Manufacturer: LW Products, or approved equal

2.4 ROUGH HARDWARE

A. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting systems. Acceptable manufacturers are Simpson, or approved equal.

B. Manufacture or fabricate items of sizes, shapes and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere furnish galvanized steel washers.

2.5 MISCELLANEOUS FABRICATIONS, FRAMING AND SUPPORTS

A. Provide miscellaneous steel framing and supports required to complete the Work.

B. Fabricate miscellaneous units to the sizes, shapes and profiles shown in the Drawings or, if not shown, of the required dimensions to receive adjacent grating, plates doors, or other work to be retained by the framing.

C. Except as otherwise shown, fabricate from structural steel shapes and plate and steel bars, all welded construction using mitered corners, welded brackets and splice plates and a minimum number of joints for field connection.

D. Cut, drill and tap units to receive hardware and similar items to be anchored to the work.

E. Equip units with integrally welded anchors for casting into concrete, bolting to structural steel or building into masonry. Furnish inserts if units must be installed after concrete is placed.

F. Galvanize all miscellaneous fabrications unless otherwise noted.

2.6 NON-SHRINK GROUT

A. Where required for anchoring, patching, or sealing, grouting and sealing compounds shall conform to the requirements of Section 03 60 00, Grouting.

2.7 MATERIALS

A. Materials listed below shall be provided unless otherwise noted in the Drawings or other sections of these specification.

B. Steel:

1. Structural W Shapes: ASTM A992.
2. Structural Shapes: ASTM A36.
3. Channels and Angles: ASTM A36.
4. Steel Plate: ASTM A36.
    a. Steel Plate to be Bent or Cold Formed: ASTM A283, Grade C.
5. Hollow Structural Sections: ASTM A500, Grade B.
6. Structural Pipe: ASTM A53, Grade B, Schedule 40 unless shown otherwise in Drawings.
7. Bar: ASTM A36 .
    a. Cold-Finished Steel Bar: ASTM A108, grade as selected by fabricator.
8. Sheet Steel: ASTM A653, Grade 33 Structural Quality.
9. Tubing: ASTM A513, Type 5, minimum 50 ksi yield strength.
10. Standard Bolts: ASTM A307; Grade A.
    a. Washers: ASTM F844.
11. High Strength Bolts: ASTM A325.
    a. Washers: ASTM F436; Type 1.
12. Nuts: ASTM A563; heavy-hex type.
13. Welding Materials: AWS D1.1; type required for materials being welded.

C. Stainless Steel:

1. Bars and Shapes: ASTM A276; Type 316.
2. Tubing: ASTM A269; Type 316.
3. Pipe: ASTM A312, seamless; Type 316.
4. Plate, Sheet, and Strip: ASTM A666; Type 316.
5. Bolts, Nuts, and Washers: ASTM A354; Type 316.
6. Welding Materials: AWS D1.6; type required for materials being welded.

D. Aluminum:

1. Structural Aluminum Shapes and Plates: ASTM B308, Alloy 6061, Temper T66, Anodic Coating Class I, anodized after fabrication.

2. Aluminum-Alloy-Drawn Seamless Tubes: ASTM B210 Alloy 6063, Temper T6.

3. Aluminum-Alloy Bars: ASTM B211 Alloy 6063, Temper T6.

4. Bolts, Nuts, and Washers: Stainless steel or Steel, galvanized.

5. Welding Materials: AWS D1.1; type required for materials being welded.

E. Bolts, Nuts, and Washers for Equipment and Piping:

1. Select fasteners for the type, grade and class required for the installation of miscellaneous metal items.

2. Carbon Steel:

   a. General: Zinc-coated, ASTM A153.
   b. Structural Connections: ASTM A307, Grade 2 (60 ksi), hot-dip galvanized.
   c. Anchor Bolts: ASTM A307, Grade 2 (60 ksi), hot-dip galvanized.
   d. Pipe and Equipment Flange Bolts: ASTM A193, Grade B-7.
   e. High Strength Bolts: ASTM F3125, Heavy Hex Head.

3. Stainless Steel: Type 316 stainless steel, Class 2; ASTM A193 for bolts; ASTM A194 for nuts.

   a. Where stainless steel bolts are in contact with dissimilar metals, glass epoxy insulating sleeves and washers shall be used to electrically isolate the bolts.

2.8 FABRICATION

A. Workmanship:

1. Use materials of the size and thicknesses shown in the Drawings or, if not shown, of the required size and thickness to produce adequate strength and durability in the finished product for the intended use as approved by the Engineer.

2. Work to the dimensions shown in the Drawings or accepted on Shop Drawings, using proven details of fabrication and support.

3. Use the type of materials shown in the Drawings or specified for the various components of work.

4. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

5. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise shown in the Drawings.

6. Form bent-metal corners to the smallest radius possible without causing grain separation or otherwise impairing the Work.

B. Fit and shop-assemble items in largest practical sections for delivery to Site.

C. Fabricate items with joints tightly fitted and secured.

D. Continuously seal join members by means of continuous welds in accordance with the recommendations of AWS, unless otherwise noted or approved.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

H. Loose Bearing and Leveling Plates:

1. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction, made flat, free from warps or twists, and of required thickness and bearing area.

2. Drill plates to receive anchor bolts and for grouting as required.

3. Galvanize after fabrication.

I. Miscellaneous Steel Trim:

1. Provide shapes and sizes for profiles shown in the Drawings.

2. Except as otherwise indicated, fabricate units from structural steel shapes and plates and steel bars, with continuously welded joints and smooth exposed edges.

3. Use concealed field splices wherever possible.

4. Provide cutouts, fittings and anchorages as required for coordination of assembly and installation with other work.

J. Fabrication Tolerances:

1. Squareness: 1/8-inch maximum difference in diagonal measurements.
2. Maximum Offset between Faces: 1/16 inch.
3. Maximum Misalignment of Adjacent Members: 1/16 inch.
4. Maximum Bow: 1/8 inch in 48 inches.
5. Maximum Deviation from Plane: 1/16 inch in 48 inches.

2.9 FINISHES

A. Steel:

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

2. Do not prime surfaces in direct contact with concrete or where field welding is required.

3. Prime-paint items with one coat, except where galvanizing is specified.

4. Coatings as specified per Section 09 90 00, Painting and Coating.

   a. Primer paint selected must be compatible with the required finish coats of paint.

   b. At locations in contact with potable water, use only primer approved for potable water use.

5. Galvanizing for Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips: ASTM A123; hot-dip galvanize after fabrication.

6. Galvanizing for Fasteners, Connectors, and Anchors:

   a. Hot-Dip Galvanizing: ASTM A153.
   b. Mechanical Galvanizing: ASTM B695; Class 50 minimum.

7. Chrome Plating: ASTM B177, nickel-chromium alloy, satin finish.

8. Sheet Steel: Galvanized.

9. Bolts: Hot-dip galvanized.

10. Nuts: Hot-dip galvanized.

11. Washers: Hot-dip galvanized.

12. Touchup Primer for Galvanized Surfaces: ASTM A780 (A780M), A1. Repair Using Zinc-Based Alloys (Heat and Stick Method).

B. Stainless Steel:

1. Satin-Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face.

2. Mirror-Polished Finish: Number 8, mirror polish with preliminary directional polish lines removed.

C. Aluminum:

1. Protection of All Aluminum:

a. Aluminum surfaces in contact with cementitious, masonry or dissimilar materials, apply the following coating system:

1) One (1) coat of epoxy primer, 1 to 2 mils dry film (D.F.).
2) Followed by two (2) coats of Bitumastic, 6 to 8 mils D.F.
3) Followed by two (2) coats of Tarset material, 6 to 8 mils D.F.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal and aluminum where Site welding is required.

B. Furnish setting drawings, diagrams, templates, instructions and directions for the installation of anchorages, such as concrete inserts, anchor bolts and miscellaneous items having integral anchors. Supply steel items required to be cast into concrete or embedded in masonry with setting templates to appropriate sections. Coordinate delivery of such items to the project Site.

3.3 INSTALLATION

A. Install items plumb and level, accurately fitted, and free from distortion or defects.

B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.

C. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction, including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.

D. Fit exposed connections accurately together to form tight hairline joints.

E. Grind joints smooth and touch-up shop paint coat.

F. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication and are intended for bolted or screwed field connections.

G. Field-weld components indicated on Drawings and Shop Drawings.

H. Perform field welding according to AWS D1.1 with regards to procedures of manual shielded metal-arc welding, the appearance and quality of welds made and the methods used in correcting welding work.

I. Obtain approval of Engineer prior to Site cutting or making adjustments not scheduled.

3.4 TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story or for every 12 feet in height, whichever is greater, non-cumulative.

B. Maximum Variation from Level: 1/16 inch in 3 feet and 1/4 inch in 10 feet.

C. Maximum Offset from Alignment: 1/4 inch.

D. Maximum Out-of-Position: 1/4 inch.

3.5 FIELD QUALITY CONTROL

A. Welding: Inspect welds according to AWS D1.1.

B. Replace damaged or improperly functioning hardware.

C. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

D. Touch up factory-applied finishes according to manufacturer-recommended procedures.

3.6 ADJUSTING

A. Adjust operating hardware and lubricate as necessary for smooth operation.

END OF SECTION

SECTION 09 90 00

PAINTING AND COATINGS

PART 1 GENERAL

1.1 SUMMARY

A. Work under this Section shall include the protective coating of all specified surfaces including all surface preparation, pretreatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.

1.2 JOB REQUIREMENTS

A. This specification is applicable to coated pipe, steel, concrete and other surfaces listed in the coating schedule at the end of this section.

B. 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 exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.

C. Related Work Specified in Other Sections: Shop coatings and/or factory finishes on fabricated or manufactured equipment may be specified in other Sections. Where specified or indicated, items with factory finishes or corrosion resistant finishes shall be coated per this Section at no additional cost to the Owner.

D. Exclusions: Do not coat the following surfaces unless specified or directed elsewhere: Stainless steel, aluminum, copper, brass, bronze and other corrosion-resistant material (except for valve bodies and piping); Electrical switchgear and motor control centers having factory finish; Fencing; Multiple coated factory-finished baked enamel or porcelain products; Concealed areas such as ducts, piping, conduits and items specified elsewhere for special linings and coatings.

E. Damaged Factory Finish: If directed by the Engineer, refinish the entire exposed surfaces of equipment chipped, scratched or otherwise damaged in shipment or installation.

F. All coating coming in contact with potable water shall be NSF approved.

1.3 CONTRACTOR SUBMITTALS

A. Coating Materials List: Contractor shall provide a coating materials list which indicates the manufacturer and the coating number, keyed to the coating systems herein. The

amount of copies to submit shall be as specified within Section 01 33 00, Submittal Procedures.

B. Coating Manufacturer's and Applicator Information: For each coating system to be used the Contractor shall submit, the following listed data.

1. Manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.

2. Manufacturer's instructions and recommendations on surface preparation and application.

3. Colors available for each product and each coat.

4. Compatibility of shop and field applied coatings (where applicable).

5. Material safety data sheet (MSDS) for each product used.

6. The manufacturer’s recommended products and procedures for field coating repairs and field preparation of field cut pipe ends.

7. The name of the proposed coating applicator shop along with certification that the applicator shop is qualified and equipped to apply the coatings systems as specified.

8. Certificate: Submit manufacturer's certificate of compliance with the specifications and standards signed by a representative in the manufacturer's employ.

9. Samples: Provide painted surface areas at the job for approval of main color selections, or submit sample on 12-inch x 12-inch sample of substrate using required finish system at Engineer’s discretion.

1.4 QUALITY ASSURANCE

A. Painter Qualifications

1. The Painting/Coating Contractor must be capable of performing the various items of work as specified.

2. The Painting/Coating Contractor shall furnish a statement stating a minimum of five (5) years practical experience and a successful history in the application of the specified products to concrete/metal surfaces. Upon request, the Painting/Coating Contractor shall substantiate this requirement by furnishing a list of references, which shall include jobs of a similar nature.

B. The Contractor shall give the Engineer a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

C. All 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.

D. 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.

E. Surface Preparation: Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.

F. Paint Products: No request for substitution shall be approved which decreases the film thickness designated or the number of coats to be applied, or which offers a change from the generic type of coating specified. Painting shall be done at such times as the Contractor and Engineer may agree upon in order that dust-free and neat work be obtained. All painting shall be in strict accordance with the manufacturer's instructions and shall be performed in a manner satisfactory to the Engineer.

G. Manufacturer's Representative: Require coating manufacturer's representative to be at job site when the first day's coating application is in progress and periodically during progress of the work.

H. Labels: Deliver to the job site in the original sealed containers with manufacturer's name, product name, type of product, manufacturer's specification or catalog number or federal specification number, and instructions for reducing where applicable.

I. 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 gage such as Mikrotest model FM, Elcometer model 111/1EZ, or approved 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 wet film gage readings and destructive film thickness tests.

J. Inspection Device: The Contractor shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gages shall be made available for the Engineer’s use at all times while coating is being done, until final acceptance of such coatings. The Contractor shall provide the services of a trained operator of the holiday detection devices until the final acceptance of such coatings.

K. Holiday Testing: The Contractor shall holiday test all coated ferrous surfaces. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested.

1. Coatings With Thickness Exceeding 20 Mils -- For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or approved 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 specified coating thickness.

2. Coatings With Thickness of 20 Mils or Less -- For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Rasor Model M1 nondestructive type holiday detector, K-D Bird Dog, or approved 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.

1.5 DELIVERY, HANDLING AND STORAGE

A. Deliver in labeled containers as specified above and store in a locked room accessible for inspection. Comply with fire and health regulations.

B. Provide adequate heat and forced mechanical ventilation for health, safety and drying requirements. Use explosion proof equipment. Provide face masks.

C. Protect adjacent surfaces with suitable masking and drop cloths as required. Remove cloths or waste from the project daily.

D. Apply to surfaces under recommended environmental conditions and within the limitations established by the material manufacturer. Do not apply coating in snow, rain, fog or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces, unless otherwise permitted by the coating manufacturer's printed instructions. Coating application may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

1.6 PROTECTION

A. Follow all safety recommendations of manufacturer regarding ventilation and danger from explosion or breathing paint fumes or skin exposure, and all applicable O.S.H.A. and other regulations.

B. Protect surface adjacent to work being coated from overspray, drips or other damage.

PART 2 PRODUCTS

2.1 GENERAL

A. Definitions: The terms "paint," "coatings" or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, tape and all other

protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.

B. General: Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer, all of which shall be plainly legible at the time of use.

C. The Contractor shall use coating materials suitable for the intended use and recommended by their manufacturer for the intended service.

D. 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, subject to the approval of the Engineer, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.

E. Colors: All colors and shades of colors of all coatings shall be as selected or specified 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 as selected from the manufacturer's standard color samples by the Engineer. Color pigments shall be lead free.

F. Protective Coating Materials: Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the Contractor shall provide the Engineer with the names of not less than 10 successful applications of the proposed manufacturer's products demonstrating compliance with this specification requirement.

G. Substitute or "Or-Equal" Submittals: Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the companies listed. The Contractor shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or equal" material that said material meets the specified requirements and is equivalent or better than the listed materials.

H. The cost of all testing and analyzing of the proposed substitute materials that may be required by the Engineer shall be paid by the Contractor. If the proposed substitution requires changes in the contract work, the Contractor shall bear all such costs involved and the costs of allied trades affected by the substitution.

2.2 INDUSTRIAL COATING SYSTEMS

A. General

Provide and apply the industrial coatings systems which follow as listed in the coating schedule, as required by these specifications and as directed by the Engineer. Coat all existing and new exposed interior or exterior surfaces and submerged and intermittently submerged surfaces as indicated, except as specifically excluded in Part 1 of this section or on the drawings or finish schedules. Coating System Numbers listed below shall be used as the Coating System code letter, and shall be used on any coating submittals or correspondence.

B. Industrial coating systems shall be as follows

1. Coating System 100 – NOT USED

2. Coating System 101 – NOT USED

3. Coating System 102

   a. Location: Unprimed or non-galvanized, continuously or intermittently submerged metal items, both interior and exterior including piping, structural steel and all other metal items not otherwise specified.

   b. Surface Preparation -- As specified herein.

   c. Coating System -- Prime, intermediate and topcoat, 4.0-6.0 mils each coat of Tnemec Series 20 Pota-Pox, or approved equal. Color as selected by Owner.

4. Coating System 103 – NOT USED

2.3 SPECIAL PIPE AND SEVERE SERVICE COATING SYSTEMS

A. General

1. The following coatings are for buried pipe and surfaces used in severe service conditions. The manufacturers' products listed in this paragraph are materials which satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated within the paragraph entitled " ‘Or-Equal’ Clause” in Section 01 33 00, Submittal Procedures.

B. Special pipe and severe service coating systems shall be as follows

1. Coating System 200: Cement Mortar Coating – NOT USED

2. Coating System 201: Hot Applied Coal Tar Epoxy Coating – NOT USED

3. Coating System 202: Coal-Tar Epoxy Coating System – NOT USED

4. Coating System 203: Fusion Bonded Epoxy – NOT USED

5. Coating System 204: Hot, Coal-Tar Enamel – NOT USED

6. Coating System 205: Hot Applied Tape – NOT USED

7. Coating System 206: Cold Applied Tape – NOT USED

8. Coating System 207: PVC Tape – NOT USED

9. Coating System 208: Mastic – NOT USED

10. Coating System 209: Polyethylene Encasement – NOT USED

11. Coating System 210: High Build Epoxy

    a. Location: Wet well and manhole interior concrete surfaces where indicated in the Contract Documents.

    b. Surface Preparation: Per manufacturer's requirements, pressure wash concrete interior and apply non-shrink grout to all voids prior to coating application.

    c. Coating System: Apply one (1) coat of Raven 405 per manufacturer's recommendations. Coating shall be applied to obtain a final coating thickness of no less than 125 mils dry film thickness.

2.4 ARCHITECTURAL COATING SYSTEMS – NOT USED

PART 3 EXECUTION

3.1 STORAGE, MIXING AND THINNING OF MATERIALS

A. Manufacturer's Recommendations: Unless otherwise specified herein, 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 all other procedures relative to coating shall be strictly observed.

B. All protective coating materials shall be used within the manufacturer's recommended shelf life.

C. Storage and Mixing: Coating materials shall be protected from exposure to cold and hot weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.2 CORRECTIONS AND CLEANUP

A. At completion any damaged, delaminated or defaced coated surfaces shall be touched up, restored and left in first class condition.

B. Any coated or finished surfaces damaged in fitting or erection shall be restored. If necessary, an entire wall shall be refinished rather than spot finished.

C. Upon completion and prior to final acceptance, all equipment and unused materials accumulated in the coating process shall be removed from the site and any spillage, spatter spots or other misplaced coating material shall be removed in a manner which will not damage surfaces.

D. Perform required patching, repair, and cleaning to the satisfaction of the Engineer.

E. Cooperate and coordinate work with the work of other trades in the removal and replacement of hardware, fixtures, covers, switch plates, etc., as required for coating.

3.3 SURFACE PREPARATION

A. General

Prepare all surfaces scheduled to receive new coating systems, as required to provide for adequate bonding of the specified coating system to the substrate material. Request review of prepared surfaces by the Engineer prior to proceeding. For existing coated surfaces, hand wash with cleaner or product recommended by coating manufacturer to properly prepare existing surface and provide for bonding of coating specified to follow. Remove any loose, peeling or flaking coating, or mildewed areas. Surface preparation minimums shall be as follows:

1. Metal items, unprimed or non-galvanized, continuously or intermittently submerged, both interior and exterior including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in conformance with SSPC-SP10, "Near-White Blast Cleaning".

2. Concrete - Clean all concrete surfaces of dust, form oil, curing compounds or other incompatible matter. Etch and prime if required by manufacturer for specified coating products to follow. Allow minimum 28-day cure of concrete prior to application of coating systems.

3. Preparation of All Existing Coated Surfaces -- Removed rough and defective coating film from material surfaces to be painted. Touch up with approved primer. Clean all greasy or oily surfaces, to be painted, with benzine or mineral before coating, or as recommended by manufacturer. For walls, patch existing nicks and gouges, sand to match wall finish.

3.4 PRIME COATING

A. Exposed Steel: Prime coat all exposed steel in accordance with SSPC PS 13.01 for epoxy-polyamide coating systems. Prime coats shall be applied following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above.

B. Galvanized Metal: After surface preparation specified above, prime galvanized metal items receiving paints as specified with Tnemec Series 66 Hi-Build Epoxaline or equal, verifying with manufacturer before application the compatibility with coatings specified to follow.

C. Shop Primed Metal: Where indicated on the plans or coating schedule and following the surface preparation procedures specified above, the Contractor shall apply intermediate and topcoats of the specified paint system to shop primed metal. The Contractor shall verify with the manufacturer(s) representative of the item(s) to be painted, before application, the compatibility of shop primers with the specified intermediate and topcoat coating systems.

D. Non-Shop Primed Metal and Piping: Prime coat all exposed metal and piping, except stainless steel, received at job site following completion of surface preparation requirements as specified above. Prime paint in accordance with SSPC PS No. 13.01 for epoxy-polyamide primers. Epoxy-polyamide primers shall conform to the standards set forth in SSPC Paint Specification No. 22.

3.5 FIELD PRIME

A. Wherever shop priming has been damaged in transit or during construction, the damaged area shall be cleaned and touched up with field primer specified herein or returned to the shop for resurfacing and repriming, at the Engineer’s discretion. Metal items delivered to the job site unprimed shall be cleaned and primed as specified herein.

3.6 APPLICATION

A. Thickness: Apply coatings in strict conformance with the manufacturer's application instructions. Apply each coat at the rate specified by the manufacturer to achieve the dry mil thickness specified. If material must be diluted for application by spray gun, build up more coating to achieve the same thickness as undiluted material. Correct apparent deficiency of film thickness by the application of an additional coat.

B. Porous Surfaces: Apply paint to porous surfaces as required by increasing the number of coats or decreasing the coverage as may be necessary to achieve a durable protective and decorative finish.

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 working 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. Use stripe coating for these areas.

F. Special attention shall be given to materials which 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. Ventilation: Adequately ventilate enclosed rooms and spaces during painting and drying periods.

H. Drying Time: Do not apply next coat until preceding coat is dry. Test non-metallic surfaces with moisture meter. The manufacturer's recommended drying time shall mean an interval under normal condition to be increased to allow for adverse weather or drying conditions. Coating manufacturer's representative shall verify by cure testing, complete cure of coatings systems used for immersion service.

3.7 COATING SCHEDULE

The following schedule indicates the coating and paint systems previously specified that apply to the project. Additional comments are added which may modify or amend the specifications.

Coating & Painting Schedule

Item	Location	Material	Coating System
Piping	Wet well	Ductile Iron	Coating System 102
Pipe Supports	Wet well	Steel	Coating System 102
Wet Well	Concrete surfaces	Concrete	Coating System 210

END OF SECTION

SECTION 26 05 00

GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Scope.
2. Definitions.
3. Reference Standards.
4. Quality Assurance.
5. Submittals.
6. Drawings.
7. Project Site Conditions.
8. Equipment Coordination.
9. Basis of Design.
10. Products.
11. Execution – General.
12. Testing.

1.2 SCOPE

A. This section specifies general requirements for electrical work. Detailed requirements for specific electrical items are specified in other sections but are subject to the general requirements of this section.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.

C. Interfaces to Equipment, Instruments, and Other Components:

1. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers, which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.

2. Provide all material and labor needed to install the actual equipment furnished. Include additional conduit, wiring, terminals, or other electrical hardware to the work, which may be necessary to make a complete functional installation, based on the actual equipment furnished:

    a. Make all changes necessary to meet the manufacturer's wiring requirements.

3. Submit all such changes and additions to the Engineer for acceptance in accordance with the General Conditions.

4. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include items that appear on Drawings or in Specifications from another discipline in the scope of Work:

    a. If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.

D. All electrical equipment and systems for the entire project shall comply with the requirements of Division 26, whether referenced in the individual equipment specifications or not:

1. The requirements of Division 26 apply to all electrical work specified in other Divisions and Sections, including HVAC controls, packaged mechanical systems, Local Control Panels (LCPs), Vendor Control Panels (VCPs), Instruments Junction Boxes (IJBs), Power Junction Boxes (PJBs) and enclosures.

2. The Owner is not responsible for any additional costs due to the failure of the Contractor to notify all Subcontractors and suppliers of the Division 26 requirements.

E. Contract Documents:

1. General:

    a. The Drawings and Specifications are complementary and are to be used together to fully describe the Work.

2. Contract Drawings:

    a. The electrical Drawings show in a diagrammatic manner, the desired locations, and arrangements of the components of the electrical work. Follow the Drawings as closely as possible. Use professional judgment and coordinate with the other trades to secure the best possible installation. Use the entire Drawing set for construction purposes.

b. Locations of equipment, control devices, instruments, boxes, and panels are approximate only, exercise professional judgment in executing the Work to ensure the best possible installation:

1) The equipment locations and dimensions shown on plans and elevations are approximate. Use the Shop Drawings to determine the proper layout, foundation, and pad requirements for final installation. Coordinate with all Subcontractors to ensure that all electrical equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.

2) The Contractor has the freedom to select any of the named manufacturers, as identified in the individual specification sections. The Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.

c. Installation Details:

1) The Contract Drawings include typical installation details, which show the means and methods the Contractor is to use to install electrical equipment. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the Engineer.

F. Utility Coordination:

1. The Contractor shall coordinate with the local electric Utility for the installation of the electrical service at the Owner's facility as specified in section 26 05 85.

G. Permits, Fees and Service Charges:

1. Coordinate and obtain inspections and final installation approval from serving utilities and other authorities having jurisdiction.

2. Contractor shall be responsible for obtaining all electrical permits and fees associated with the electrical system as required, unless specifically excluded or listed as paid by the Owner (i.e. electrical service).

1.3 DEFINITIONS

A. WIRING, ELEMENTARY OR SCHEMATIC DIAGRAM: A schematic (elementary) diagram shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and

its functions without regard to the actual physical size, shape, or location of the component devices or parts.

B. ONE-LINE DIAGRAM: A one-line diagram shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.

C. BLOCK DIAGRAM: A block diagram is a diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.

D. CONNECTION DIAGRAM: A connection diagram includes all of the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. This diagram shall be (a) in a form showing interconnecting wiring only by terminal designation (wireless diagram), or (b) a panel layout diagram showing the physical location of devices plus the elementary diagram.

E. INTERCONNECTION DIAGRAM:

1. Interconnection diagrams shall show all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams which interface to the interconnection diagrams. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of the individual wires clearly shown. Wireless diagrams and wire lists are not acceptable.

2. Each wire identification as actually installed shall be shown. The wire identification for each end of the same wire shall be identical. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified in the equipment complete with individual terminal identification.

3. All jumpers, shielding and grounding termination details not shown on the equipment connection diagrams shall be shown on the interconnection diagrams. Wires or jumpers shown on the equipment connection diagrams shall not be shown again on the interconnection diagram. Signal and DC circuit polarities and wire pairs shall be shown. Spare wires and cables shall be shown.

F. ARRANGEMENT, LAYOUT, and/or OUTLINE DRAWINGS: An arrangement, layout, and or outline drawing is one which shows the physical space and mounting requirements of a piece of equipment. It may also indicate ventilation requirements and space provided for connections or the location to which connections are to be made.

1.4 REFERENCE STANDARDS

A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of

conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or other- wise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NECA-1	National Electrical Contractors Association – Standard Practices for Good Workmanship in Electrical Contracting
NFPA-70 NFPA-70E	National Electrical Code (NEC) Electrical Safety in the Workplace
IEEE	Institute of Electrical and Electronic Engineers
NEMA	National Electrical Manufacturers Association
IES	Illumination Engineering Society
IBC	International Building Code
WAC	Washington Administrative Code

1.5 QUALITY ASSURANCE

A. IDENTIFICATION OF LISTED PRODUCTS:

1. Electrical equipment and materials shall be listed for the purpose for which they are to be used, by an independent testing laboratory. Three such organizations are Underwriters Laboratories (UL), Factory Mutual (FM), and Electrical Testing Laboratories (ETL). Independent testing laboratory shall be acceptable to the inspection authority having jurisdiction.

2. When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority, to undergo inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price. Contractor shall comply with Washington Administrative Code regulations concerning Listing requirements for electrical equipment.

B. FACTORY TESTS: Where specified in the individual product specification section, factory tests shall be performed at the place of fabrication and performed on completion of manufacture or assembly. The costs of factory tests shall be included in the contract

C. SUPERVISION: The Contractor shall maintain adequate supervision of the work and shall have a responsible person in charge during all times the work in under contract and in progress, and or as necessary for coordination with other work.

D. DELIVERY AND STORAGE:

1. Delivery and storage per Section 01 66 00.

1.6 SUBMITTALS

A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

b. Failure to include a list of the specification section deviations 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.

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.

b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.

c. Submittals are to made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

4. Provide Seismic calculations for anchoring and support of equipment as required in Section 01 41 20.

5. Interconnection diagram: The Contractor shall prepare interconnection diagrams depicting all cable requirements together with their actual terminations as specified.

6. Conduit layout drawings indicating size, location, and support, for all conduits other than single runs of 1-inch diameter or less cast in concrete construction.

   a. Conduit layout drawings shall illustrate a system which conforms to the requirements of the project.

   b. For changes to the layouts shown on the contract documents, provide engineering design and calculations signed and sealed by a Professional Engineer registered in State of Washington. Engineering design and calculations shall demonstrate that the proposed layout does not impair or significantly reduce the design structural strength.

7. Safety disconnect switch list including legend with equipment tag, equipment description, and power feeder circuit source and location information.

8. Maintenance Data: For all equipment and for components to include in maintenance manuals specified in Division 1 General Requirements. In addition to requirements specified in Section 01 77 00 - Project Closeout and 01 78 23 - Operations and Maintenance Data include the following:

   a. Routine maintenance requirements for equipment and components.

1.7 WARRANTY

A. Provide a written warranty covering the work done under this Division as required by the General Conditions.

B. Apparatus:

1. Free of defects of material and workmanship and in accord with the Contract Documents.

2. Built and installed to deliver its full rated capacity at the efficiency for which it was designed.

3. Operate at full capacity without objectionable noise or vibration.

C. Systems: Any system damage caused by failures of any system component shall be included.

1.8 DRAWINGS

A. Where the Contractor is required to provide information on drawings as part of the specified work, such drawings shall be prepared on 11-inch by 17-inch paper, and on a USB storage device in AutoCAD 2020. Drawings shall be complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing. Drawing quality and size of presentation shall be such as to permit 50 percent reduction of such drawings for insertion in operation and maintenance manuals. Drawings deemed illegible shall be rejected.

B. Where the Contractor is required to provide equipment or system submittal information on drawings as part of the specified work, such drawings shall be prepared on 11-inch by 17-inch paper and shall be included electronically in PDF format. Drawings shall be complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing. Drawing quality and size of presentation shall be such as to permit 50 percent reduction of such drawings for insertion in operation and maintenance manuals. Drawings deemed illegible shall be rejected.

1.9 PROJECT/SITE CONDITIONS

A. GENERAL: Unless otherwise specified, equipment and materials shall be sized and derated for the ambient condition of 40 degrees C at an elevation ranging from sea level to 1000 feet without exceeding the manufacturer's stated tolerances.

B. HAZARDOUS (CLASSIFIED) AREAS: Hazardous areas are identified on the drawings and shall be in accordance with the NEC, NFPA 820.

C. SEISMIC: Electrical equipment supports, and anchorage shall be designed and installed in accordance to Section 01 41 20.

1.10 ELECTRICAL NUMBERING SYSTEMS

A. TAGGING: All circuit raceways and armored cables shall be tagged at all terminations, panels, MCCs, pull boxes, junction boxes, etc. in accordance with the assigned numbers

on the circuit/raceway schedule and schematic/plan drawings. The tags shall be installed in a clean and high workmanship manner. In addition to tags at the terminations, exposed raceways and armored cables shall be tagged at each side of concealment.

B. PREFIX MODIFIERS: The following prefix modifiers shall be used when scheduling/tagging cables and raceway:

Raceway Prefix	Type of Function
H	Power above 600V
P	Power 120V to 600V
C	Control or power - 120V or less
S	Low level signal (less than 90-volt communication or less than 30-volt instrumentation)
D	Data
PSP, CSP	Spare power, spare control

C. RACEWAY NUMBERS: Where circuit/raceway numbers have not been assigned, Contractor shall assign raceway numbers in accordance with the system outlined in the drawings.

1.11 CONDUCTOR NUMBERS:

A. WIRE MARKERS: All control and signal conductors in panels, pull boxes, power, instrument, and relay compartments of motor control centers, control cabinets, instrument cabinets, field cabinets and control stations, as well as connections to mechanical equipment, shall be tagged at each end with legible, coded tight-fitting wire-marking sleeve showing the complete wire designation. The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink. The figures shall be 1/8 inch high. Sleeves shall be yellow or white tubing, sized to fit the conductor insulation. The sleeves shall be shrunk to fit the conductor with hot air after installation. They shall be T&B, SHRINK-KON HVM or equal. Adhesive strips are not acceptable. Conductors size No. 10 AWG or smaller shall have identification sleeves. Conductors 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.

B. INTERNAL WIRING:

1. Wiring within a single enclosure shall be marked with the basic wire and terminal number at each end. The wire number shall designate the terminal or equipment number at each end of the wire separated by a slash.

C. FIELD WIRING: All field wiring shall have wire labels at each end. The labels shall be marked with the output terminal number at the original equipment (local control panel) and the remote device terminal # (if applicable) and tag name separated by a slash. Conductors shall be identified with numbers at both ends. Conductor tag numbers shall be the conductor number specified on the control diagram or if not shown, shall follow the convention below.

1. Wires from Local Control Panels shall be labeled with panel number (MCP)-terminal number (TB1-12)] (MCP/TB1-12)

2. Wires from devices, instruments etc. shall have the instrument or device name and terminal number if applicable. Equipment name is typically DEVICE TYPE - NUMBER. (HS2510) (TSH2510) (FIT2562)

D. EXAMPLE for a control cable from the Pump Terminal Panel (PTP) to the level transmitter (LIT1) - the wire tag number ends shall be LIT1/PTP+, LIT/PTP-.

1.12 EQUIPMENT COORDINATION

A. The Contractor is responsible to coordinate the equipment supplied from various manufacturers and vendors. This includes but is not limited to:

1. Obtaining specific information on equipment ratings and sizes and verifying the electrical components supplied meet, or match the requirements such as voltage, phase, frequency, starter types, etc.

2. Shall provide equipment that will fit within the space allocated and meet OSHA and NEC clearances.

3. Shall provide coordinated electrical installations with the supplied equipment's electrical power and control requirements.

4. Shall provide power and control equipment, wiring, and raceways to meet the requirements of the mechanical equipment supplied.

5. Shall provide all necessary control wiring and components for any special requirements from an equipment manufacturer.

B. The Contractor shall verify as a minimum:

1. Correct voltage, phase and frequency
2. Size and space requirements
3. Mounting requirements
4. Correct motor starter type and NEMA size
5. Proper coordination with the controls and control System Integrator

C. Any discrepancies between the electrical equipment and other equipment shall be brought to the immediate attention of the Owner.

D. The Contractor shall assure that no instrumentation or control interferences are created by the motor or load wiring. The Contractor shall coordinate with the manufacturer to provide necessary separation of conductors or shielding and/or filtering equipment as required. If interferences do occur, the Contractor shall be responsible to take corrective action at no additional cost to the Owner.

E. WIRING FOR VENDOR PACKAGES:

1. Equipment specifications indicate when the Vendor is responsible for providing interconnection wiring between components of a Vendor package that are installed on separate skids or assemblies. In this circumstance, interconnection wiring between skids or assemblies in a Vendor package is scheduled as “Vendor Wiring” in the conduit/cable schedules.

2. Where equipment specifications do not specify Vendor furnished wiring between skids or assemblies in a Vendor package, the Contractor shall provide and install interconnection wiring between skids or assemblies per the Vendor’s interconnection wiring requirements. Interconnection wiring between skids or assemblies in a Vendor package that is furnished and installed by the Contractor is not scheduled in the conduit/cable schedules.

3. Determination of cable requirements.

    a. Coordinate cable/conductor requirements with the selected Vendors to determine the correct wiring required to interconnect the package system components/skids.

    b. Wiring between Vendor furnished components shipped on separate skids or assemblies shall conform to requirements specified in Division 25 and Division 26.

    c. Wiring between the plant control system and Packages system components/skids are specified in the conduit/cable schedules.

d. Wiring between external power supplies and the packaged system components/skids are specified in the conduit/cable schedules.

4. Assign numbers and tagging for unscheduled raceway, and cable between Vendor furnished components on separate skids or assemblies as specified in Section 26 05 00. Coordinate this information in submittals, record drawings, and O&M manuals provided under this contract.

5. Contract documents shall be updated in the record drawing set to include the work provided for wiring the vendor packages.

1.13 BASIS OF DESIGN

A. The basis of the mechanical and electrical design is the installation of equipment and motors as shown in the electrical one-line drawing(s) and load/panel schedules. In the event that different equipment motors are provided in order for the vendor's equipment to meet mechanical performance requirements, the contractor shall coordinate various suppliers, vendors, and subcontractors to change the required electrical conduit, cables, breakers, motor control center sections, starters units and accessories, etc. as necessary to meet the vendor's equipment installation requirements of the National Electrical Code. The traits and characteristics of all provided materials, equipment, and devices shall meet the specifications. These changes to materials, equipment, and devices shall be at no cost to the Owner. Electrical submittal information shall be coordinated with the equipment and motors provided.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. GENERAL: Equipment and materials shall be new and free from defects. All material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.

B. EQUIPMENT FINISH: Unless otherwise specified, electrical equipment shall be painted by the manufacturer as specified in Section 09 90 00.

C. GALVANIZING: Where specified, galvanizing shall be in accordance with Section 05 50 00.

2.2 WIRE MARKERS

A. Each power and control conductor shall be identified at each terminal to which it is connected. Conductors size No. 1 AWG or smaller shall have identification sleeves.

Conductors No. 2 AWG and larger shall use cable markers of the locking tab type. Tabs shall be white plastic with conductor identification number permanently embossed.

B. Conductors shall be identified in accordance with Section 26 05 00. Adhesive strips are not acceptable.

C. The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink with figures 1/8 inch high. Sleeves shall be yellow or white tubing and sized to fit the conductor insulation. Shrink the sleeves with hot air after installation to fit the conductor.

D. Conductor and Wire Marker Manufacture:

1. TMS Thermofit Marker System by Raychem Co
2. Sleeve style wire marking system by W. H. Brady Co.
3. Or approved equal

2.3 RACEWAY TAGS

A. Tags shall be:

1. Manufactured of permanent metal or heavy mill plastic.

2. Fastened to the raceways at both ends of the tag with permanent fasteners.

a. Fastened to the raceways at both ends of the tag with permanent fasteners.

3. Tag numbers shall be 1-inch tall and machine printed. Hand labeled tags are unacceptable.

2.4 NAMEPLATES

A. Nameplates shall be provided on all electrical devices, including but not limited to motor control equipment, MCC cubicles/cells/buckets, control stations, junction boxes, panels, harmonic filters, instruments, disconnect switches, indicating lights, meters, and all electrical equipment enclosures.

B. Nameplates shall also be provided on all electrical panel interior equipment, including but not limited to relays, circuit breakers, power supplies, terminals, contactors, and other devices.

C. Equipment nameplates shall have both the equipment name and number.

D. Nameplates shall be made of 1/16-inch thick machine engraved laminated phenolic having black letters not less than 3/16” high on white background or as shown on the drawings or other sections of the specifications. Nameplates on the interior of panels

shall be White Polyester with printed thermal transfer lettering and permanent pressure sensitive acrylic; TYTON 822 or approved equal. All nameplates shall include the equipment name and number (and function, if applicable).

E. Provide warning nameplates on all panels and equipment which contain multiple power sources. Lettering shall be white on red background.

F. Nameplates shall be secured to equipment with stainless steel screws/fasteners.

G. Nameplates for disconnect switches shall contain name and number as well as voltage, phases and colors of conductors.

2.5 TERMINAL BLOCKS

A. GENERAL:

1. GENERAL:

a. Terminal Blocks for all contractor supplied equipment and devices shall be manufactured by Allen Bradley, Bussmann, Phoenix Contact, or approved equal.

b. Unless otherwise specified, terminal blocks shall be panhead strap screw type. Terminals shall be provided with integral marking strips which shall be permanently identified with the connecting wire numbers as shown on the drawings. Terminal blocks for P-circuits (power 120-600 volts) shall be rated not less than the conductor current rating and shall not be rated less than 600 volts AC. Terminal blocks for C-circuits (control and/or control power 120 volts or less) and S-circuits (signal) shall be rated not less than 20 amperes and shall not be rated less than 600 volts AC. Terminals shall be tin-plated. Insulating material shall be nylon. Terminal blocks shall be in accordance with section 26 27 16 for all electrical equipment.

c. Provide terminals for all wire connections to field wiring and internal power distribution. Analog loops that are 24 VDC powered shall have a knife switch or fused terminals with pivoting lever to disable the loop if necessary.

d. Connections shall have screw terminals capable of terminating 2 #14 AWG stranded wires. Terminals shall be DIN rail strip mounted. Provide number strips for terminal blocks that are referenced by the wire marker. Provide bridge bars for jumpering between terminal blocks. Provide end clamps to separate and terminate terminal block groups. Provide end covers for groups of terminal blocks in sets to match the number points associated with individual I/O cards in the PLC block.

e. Provide Separation Plates on each side of terminals that are at a different potential or polarity than surrounding terminals.

f. Provide clear plastic DIN rail mounted nametag stanchions for each block of terminations. Each nametag shall hold a preprinted label designating the PLC bus and PLC block that terminates to that set of terminals.

g. Terminals shall be mounted such that there is a minimum of 1.5 inches of clear space on both sides of the terminal; for ease of wiring.

h. Mount all terminals strips on 2-inch standoffs.

i. Provide 10 spare terminals or 5% whichever is the greater amount, spare (non-installed) replacement terminals for each type used.

j. Provide wired terminals to match the number of points supplied on each installed I/O card or spare slot in a PLC cabinet.

B. DIGITAL TERMINALS:

1. Terminal Blocks for use in general purpose and digital input terminations shall be Phoenix Contact UK 5, or approved equal. Provide double high terminals for general purpose.

2. Where space is limited for the required number of digital input points double high terminals are permitted if first approved by the Owner.

C. ANALOG TERMINALS:

1. Terminal Blocks for use in analog input terminations shall be knife disconnect, with socket for analog isolator Phoenix Contact URELG-PMTK, or approved equal.

2. Terminal blocks for analog outputs shall be fused, double high with a separate ground terminal.

3. The wire used for analog inputs and outputs shall be multi-conductor #22 twisted pairs with an overall shield. Provide 4 & 8 pairs to match the input or output cards. Wire pairs shall be numbered and colored red for + and black for -. Use BELDEN-M 9520 CMG or approved.

D. FUSED TERMINALS:

1. Fuse terminal blocks shall be hinged disconnect level type with “blown fuse” indicators. PHOENIX CONTACT UK 5 HESI series, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

A. CONSTRUCTION

1. The work under Division 26 shall be performed in accordance with these specifications.

2. Unless otherwise detailed or dimensioned, electrical layout drawings are diagrammatic. The Contractor shall coordinate the field location of electrical material or equipment with the work of other disciplines and subcontractors. Minor changes in location of electrical material or equipment made prior to installation shall be made at no cost to the Owner.

3. The Contractor shall perform core drilling required for installation of raceways through concrete walls and floors. Locations of floor penetration, as may be required, shall be based on field conditions. Verify all exact core-drilling locations based on equipment actually furnished as well as exact field placement.

B. SITE VERIFICATION:

1. Contractor to visit project site and examine existing site conditions before submitting bid.

2. Verify requirements for permanent and temporary power, as required.

3. Identify any conditions that might prevent the installation of equipment as intended and inform the Owner's representative.

4. Determine requirements for cutting, patching, excavating, trenching, core drilling or similar.

5. Additional cost will not be approved due to Contractor's failure to complete a site examination of existing conditions and including any items necessary for a practical resolution.

C. HOUSEKEEPING:

1. Electrical equipment shall be protected from dust, water and damage. Control panels and generator shall be wiped free of dust and dirt, kept dry, and shall be vacuumed on the inside within 30 days of acceptance of the work.

2. Before final acceptance, the Contractor shall touch up any scratches on equipment as specified in Section 09 90 00.

3. Electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction shall be adequately protected.

D. ELECTRICAL EQUIPMENT LABELING:

1. Electrical equipment shall have field marked signs and labeling to warn qualified persons of the potential electric arc flash hazards per NEC Article 110.16 Flash Protection.

2. Electrical distribution equipment and utilization equipment shall be provided with field labels to identify the power source and the load as specified. Refer to NEC Article 110.22 for Identification of Disconnecting Means installation criteria. Specific information is required such as the equipment tag number and equipment description of both the power source and the load equipment.

E. MOTOR CONNECTIONS: Verify all wiring for motor terminations including terminal blocks located in the Pump Terminal Panel are adequately sized per the manufacturer. Ensure proper cord-grip for manufacturer pump cabling. Verify all connections with pump manufacturer for motor and motor protection to ensure compatibility with the proposed contract design.

F. CONDUCTOR INSTALLATION: An enclosure containing disconnecting means, overcurrent devices, or electrical equipment shall not be used as a wireway or raceway for conductors not terminating within the enclosure. Provide wireways, raceways, termination boxes, or junction boxes external to the enclosure for the other conductors.

3.2 DELIVERY, STORAGE AND HANDLING

A. PROCEDURES: Section 01 66 00

3.3 TESTING

A. GENERAL: Prior to energizing the electrical circuits, insulation resistance measurements tests shall be performed using a 500-volt megohmmeter to verify the conductor is acceptable for use on the project. The test measurements shall be recorded on the specified forms and provided in accordance with this section and Section 26 05 19.

B. INSULATION RESISTANCE MEASUREMENTS:

1. GENERAL:

a. Insulation resistance measurements shall be made on conductors and energized parts of electrical equipment (600V or less). Minimum acceptable values of insulation resistance shall be in accordance with the applicable ICEA,

NEMA or ANSI standards for the equipment or material being tested, unless otherwise specified. The ambient temperature at which insulation resistance is measured shall be recorded on the test form.

b. Insulation resistance measurements shall be recorded. Insulation with resistance of less than 10 megohms is not acceptable.

2. CONDUCTOR AND CABLE TESTS: The phase-to-ground insulation resistance shall be measured for all circuits rated 120 volts and above except lighting circuits. Measurements may be made with motors and other equipment connected. Solid state equipment shall be disconnected, unless the equipment is normally tested by the manufacturer at voltages in excess of 1000 volts DC.

3. MOTOR TESTS: Motors shall have their insulation resistance measured before they are connected. Insulation resistance values less than 5 megohms are not acceptable. Verify requirements with manufacturer.

C. OPERATIONAL TEST CHECKOUT: Prior to functional testing, all protective devices shall be adjusted and made operative.

1. Submit a description of the proposed operational test procedures prior to the performance of the checkout.

2. Prior to energization of equipment, perform an operational checkout of the control circuit. Checkout:

a. Energizing each control circuit.
b. Operating each control device, alarm device, or monitoring device.
c. Operate each interlock to verify that the specified action occurs.

D. Verify motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation or momentary energization.

E. FUNCTIONAL TESTING

1. Contractor to support the I&C contractor for functional (start-up) testing.

a. At a minimum the contractor shall provide assistance in testing field devices and verifying the functions as required, ensuring a complete and operational system.

2. Contractor to simulate power loss and verify and test full system operation while on generator, as well as after re-transfer back to normal power.

3.4 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable switches and circuit-breaker trip ranges.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.6 OPERATION AND MAINTENANCE MANUALS

A. Comply with Section 01 77 00 - Project Closeout 01 78 23 - Operations and Maintenance Data and Part 1 of this specification.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE CONDUCTORS, WIRES AND CABLES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Scope.
2. Reference Standards.
3. Quality Assurance.
4. Definitions.
5. Submittals.
6. Products.
7. Execution.

1.2 SCOPE

A. This section specifies cables, conductors and fibers including:

1. Stranded copper cables, conductors, and wire rated 600 volts insulation used for power; lighting, analog, digital, or pulse signals and control circuits.

2. Copper cables and coax cable rated 300-volt insulation used for data, communication, and signaling.

1.3 REFERENCE STANDARDS

A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

B. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

1. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that

organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ICEA S-95-658/ NEMA WC70	Non-shielded 0-2kV Cables
NFPA 70	National Electric Code (NEC)
UL 44	Rubber-Insulated Wires and Cables
UL 83	Thermoplastic-Insulated Wires and Cables

1.4 QUALITY ASSURANCE

A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work

B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from the date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 DEFINITIONS

A. LOW LEVEL ANALOG: A signal that has a full output level of 100 millivolts or less. This group includes thermocouples and resistance temperature detectors.

B. PULSE FREQUENCY: Counting pulses such as those emitted from speed transmitters.

C. HIGH LEVEL ANALOG: Signals with full output level greater than 100 millivolts but less than 30 volts, including 4-20 mA transmission.

D. DISCRETE EVENTS: Dry contact closures monitored by solid state equipment. If the conductors connecting to dry contacts enter enclosures containing power or control circuits and cannot be isolated from such circuits in accordance with NEC Article 725, this signal shall be treated as low voltage control.

E. LOW VOLTAGE CONTROL: Contact closures monitored by relays, or control circuits operating at less than 30 volts and 250 milliamperes.

1.6 SUBMITTALS

A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

    a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

    b. Failure to include a list of the specification section deviations 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.

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

    a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.

    b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.

    c. Submittals are to made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

4. Catalog cuts showing information of the conductors and cables to be supplied under this section.

5. Field test reports showing conductor and cable insulation resistance test results.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers are listed in the Cable Specification Sheets located at the end of this specification section.

2.2 GENERAL

A. UNSCHEDULED CONDUCTORS AND CABLES:

1. Where not specified on the Drawings, conductors and cables shall be sized in accordance with the National Electrical Code for the particular equipment served with the minimum size as specified herein. Unscheduled conductors shall be sized by the Contractor in accordance with NEC tables and to limit voltage drop to 3 percent.

2. Unscheduled conductors with insulation shall be provided in accordance with the CABLE SPECIFICATIONS in TABLE 2 according to the purpose.

B. CABLE SPECIFICATION SHEETS (CABLESPEC): General requirements for conductors and cables specified in this Section are listed on CABLESPEC sheets.

2.3 COLOR CODING

A. POWER AND CONTROL CABLES:

1. Wire coloring shall conform to the color code shown in the table below.

2. Insulation on phase conductors run in conduits sizes #10 AWG and smaller shall be colored, #8 AWG and larger may have black insulation with plastic tape of the appropriate color from the table below.

3. Insulation on the grounded conductor (neutral) sizes #8 AWG and smaller shall be colored, #6 AWG and larger may have black insulation with plastic tape of white or gray in accordance with the table below.

Description	120/240V	277/480V	Control
Phase A (Left)	Black	Brown	--
Phase B (Center)	Red	Orange	--
Phase C (Right)	Blue	Yellow	--
Neutral	White	Gray	White
Ground	Green	Green	Green
120 VAC Control	--	--	Red
120 VAC Control Neutral	--	--	White
DC Control (+)	--	--	Blue
DC Control (-)	--	--	White-Blue Stripe
Signal (+)	--	--	Red
External Source	--	--	Yellow
Intrinsic Safe	--	--	Purple

4. All control wiring in control panels or other enclosures that is powered from an external source and is not disconnected by the control panel disconnect shall be terminated at a disconnecting terminal block upon entering the enclosure. The color of the wire shall then be changed to yellow to identify it as being powered from an external source. Provide identification nameplate on exterior of enclosure to indicate sources of external power.

5. All wiring in industrial machines and equipment shall be in accordance with NFPA 79. Notify owner of any deficiencies noted during installation.

6. Multi-conductor power cable colors shall be manufacturer's standard.

7. Cables sized No. 6 AWG and larger may be black with colored 3/4-inch vinyl plastic tape applied in 3-inch lengths around the cable at each end. The cables shall be tagged at terminations and in pull boxes, hand holes and manholes.

B. SIGNAL AND DATA CABLES: Unless otherwise specified, cables shall be color coded black and white for pairs or black, red, and white for triads.

2.4 POWER AND CONTROL CONDUCTORS AND CABLE, 600 VOLT

A. SINGLE CONDUCTOR: Single conductor cable shall be stranded copper and shall be used in conduits for power and control circuits. Single conductor cable shall be provided in accordance with CABLESPEC "XHHW" type of conductors unless otherwise specified.

2.5 SIGNAL, DATA AND INSTRUMENTATION CABLES

A. GENERAL:

1. Signal cable shall be provided for instrument signal transmission, alarm, communication, and other circuits as specified. Circuit shielding shall be provided in addition to cable shielding.

2. Single circuit signal cable shall be provided in accordance with CABLESPEC "INS," unless otherwise specified.

3. Terminal blocks shall be provided at cable junction for running signal leads and shield drain wires. Each conductor shall be identified at such junctions.

a. Shields shall not be used as a ground path.

b. Shields shall be grounded at one end only. Ground at master control cabinet.

c. Signal, data, and communication cables shall be terminated and spliced on terminal strips properly mounted and labeled in accordance with this Section and Section 26 05 00. No exceptions.

4. CABLE SPECIFICATION SHEETS (CABLESPEC): General requirements for conductors and cables specified in this Section are listed on CABLESPEC sheets in Section 26 05 19-3.07.

2.6 WIRE MARKERS

A. 600 VOLT AND 300 VOLT RATED CONDUCTORS:

1. Per 26 05 00 Paragraph 2.2.

2.7 SPLICING AND TERMINATING MATERIALS

A. 600-VOLT AND 300-VOLT RATED CONDUCTORS:

1. Connectors shall be tool applied compression type of correct size and UL listed for the specific application. Connectors shall be tin-plated high conductivity copper. Connectors for wire sizes No. 10 AWG and smaller shall be nylon self-insulated, ring tongue or locking-spade terminals. Connectors for wire sizes No. 8 AWG and larger shall be one-hole lugs up to size No. 3/0 AWG, and two-hole or four-hole lugs for size No. 4/0 and larger. Mechanical clamp, dimple, screw-type connectors are not acceptable.

2. In-line splices and taps shall not be used. All circuits shall be continuous though all junction boxes, wireways, pull boxes, etc. until the circuit conductors are

terminated at suitable terminal strips within motor control centers, PLC cabinets and panels, distribution panels, local control stations, etc.

2.8 CORD GRIPS

A. Cord grips shall be provided where specified on the Drawings to attach flexible cord to equipment enclosures. Cord grips shall consist of a threaded aluminum body and compression nut with a neoprene bushing. Cord grip shall provide a watertight seal at enclosure interface and sized to accommodate the flexible cord.

B. Cord grips shall be provided where specified on the Drawings to support flexible cord to hangers. Cord grips shall consist of extra-large reinforced eyes and stainless-steel wire mesh for strain relief.

PART 3 EXECUTION

3.1 GENERAL

A. Conductors shall be identified at each connection terminal and at splice points. The identification marking system shall comply with Section 26 05 00.

B. Pulling wire and cable into conduit or trays shall be completed without damaging or putting undue stress on the insulation or jacket. Manufacture recommended and UL Listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable.

C. Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed. Where wire or cable exits a raceway, a wire or cable support shall be provided.

D. All wiring shall be stripped to an appropriate length and terminated at a terminal strip. Ensure terminal block termination point is in contact with the conductor and not the wire insulation.

3.2 600-VOLT CONDUCTOR AND CABLE

A. Conductors in panels and electrical equipment shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing is not necessary in plastic panel wiring duct or wall mounted steel raceway used above countertops. Lacing shall be made up with plastic cable ties. Cable ties shall be tensioned and cut off by using a tool specifically designed for the purpose such as a Panduit GS2B. Other methods of cutting cable ties are unacceptable.

B. Conductors crossing hinges shall be bundled into groups not exceeding 10 to 15 conductors and protected using nylon spiral flexible covers to protect conductors. Provide oversized plastic panel wiring duct within panels and panelboards.

C. Raceway fill limitations shall be as defined by NEC.

D. Motor terminations shall be made with manufacturer's cabling wired to terminal blocks located in the Pump Terminal Panel. Motor wiring from controller shall be terminated on terminal strips provided interior to the Pump Terminal Panel.

3.3 SIGNAL CABLE

A. Circuits shall be run as individually shielded twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever 3-wire circuits are required. Terminal blocks shall be provided at instrument cable junctions, and circuits shall be identified at such junctions unless otherwise specified. Signal circuits shall be run without splices between instruments, terminal boxes, or panels.

B. Shields shall not be used as a signal conductor.

C. Common ground return conductors for two or more circuits are not acceptable.

D. Unless otherwise specified, shields shall be bonded to the signal ground bus at the Master Control Panel and isolated from ground and other shields at other locations. Terminals shall be provided for running signal leads and shield drain wires through junction boxes.

E. Cable for low-level instrumentation circuits shall be run continuously between final terminations without splices or intermediate terminal blocks unless otherwise specifically shown or specified.

F. Spare circuits and the shield drain wire shall be terminated on terminal blocks at both ends of the cable run and be electrically continuous through terminal boxes. Shield drain wires for spare circuits shall not be grounded at either end of the cable run.

3.4 INSTALLATION

A. Raceway fill shall be as scheduled, and shall not exceed NEC limitations.

B. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:

1. Where specifically indicated on the drawings.

2. Where field conditions dictate and written permission is obtained from the Owner.

3. Control circuits shall be isolated from the feeder and branch power and instrumentation circuits but combining of control circuits with power is permitted as noted below.

    a. The combinations shall comply with the following:

        1) 12 VDC, 24 VDC and 48 VDC may be combined.
        2) All AC circuits shall be isolated from all DC circuits.
        3) All intrinsically safe circuits shall be separated from other circuits by placing them in separate conduit or a 2" separation of air space.

4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.

    a. The combinations shall comply to the following:

        1) Analog signal circuits may be combined.
        2) Digital circuits may be combined but isolated from analog signal circuits.

C. Pulling wire and cable into conduit shall be completed without damaging or putting undue stress on the cable insulation. Only UL listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Raceway construction shall be complete, cleaned, and protected from the weather before cable is placed.

D. Whenever a cable leaves a raceway, a cable support shall be provided. Conductors in panels and electrical equipment shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Lacing is not necessary in plastic panel wiring duct. Conductors crossing hinges shall be bundled into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.

E. Slack shall be provided in junction and pull boxes, hand holes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls of the box. Amount of slack shall be equal to largest dimension of the box. Where plastic panel wiring duct is provided for wire runs, lacing is not required. Plastic panel wiring duct shall not be used in manholes and hand holes.

F. Do not exceed cable manufacturer's maximum recommended pulling tension. Use dynamometer or break-away swivel on pulls exceeding 150 feet.

G. Observe manufacturer's minimum recommended pulling and training radii.

H. In-line splices and tees are not allowed.

I. Ground cable shields at one end only. Unless otherwise specified, ground the shields at the panel end.

J. Protect all cables against moisture during and after installation.

K. Install and ground token passing bus cable in accordance with IEEE 802.4. Attach trunk cable to walls and ceilings with PVC clamps with clamp backs at 4- foot intervals.

L. Install and ground Ethernet cable in accordance with IEEE 802.3. Attach trunk cable to walls and ceilings with PVC clamps with clamp backs at 4-foot intervals.

M. Signal and control cable suspended into the wet well shall be provided with heavy duty wire mesh cord grip of flexible stainless-steel wire to take the tension from the cable termination. Strain relief system shall be suitably anchored.

N. Circuits provided under this Section shall not be direct buried.

3.5 TERMINATIONS

A. Terminations shall be on terminators as identified in Section 26 05 00.

B. Each conductor shall be identified with a wire marker at each terminal to which it is connected. The marking system shall comply with Section 26 05 00.

C. Electrical spring connectors (wire nuts) shall not be used for any purpose on any cable specified under this Section except for receptacle and lighting circuits. Lugs and connectors shall be installed with a compression tool.

3.6 TESTING

A. GENERAL:

1. Perform insulation resistance testing of all power and control circuits below 600 volts with a 500-volt megohmmeter. Provide a test report of the results and submit to the Owners representative prior to final inspection. Equipment which may be damaged during this test should be disconnected.

B. INSTRUMENT CABLE:

1. Each signal pair or triad shall be tested for electrical continuity. Any pair or triad exhibiting a loop resistance of less than or equal to 50 ohms shall be deemed satisfactory without further test. For pairs with greater than 50-ohm loop resistance, the Contractor shall calculate the expected loop resistance considering loop length and intrinsic safety barriers if present. Loop resistance shall not exceed the calculated value by more than 5 percent.

2. Each shield drain conductor shall be tested for continuity. Shield drain conductor resistance shall not exceed the loop resistance of the pair or triad.

3. Each conductor (signal and shield drain) shall be tested for insulation resistance with all other conductors in the cable grounded.

4. Instruments used for continuity measurements shall have a resolution of 0.1 ohms and an accuracy of better than 0.1 percent of reading plus 0.3 ohms. A 500-volt megohmmeter shall be used for insulation resistance measurements.

3.7 CABLE SPECIFICATION SHEETS (CABLESPEC)

A. GENERAL: Conductor, wire, and cable types for different locations, service conditions and raceway systems are specified on individual cable specification sheets. Scheduled and unscheduled conductors, wires, and cables shall be installed in accordance with the CABLESPEC SHEETS.

B. CABLESPEC SHEETS: The following CABLESPEC sheets are included in this section:

CABLESPEC	Volts	Product	Purpose
XHHW	600	Single conductor cross- linked polyethylene power and control cable	Power and control conductors for use in conduit raceways.
INS	600	Single Pair/Triad #18 ST plus overall shield,	Instrumentation

CABLE SPECIFICATION SHEETS (CABLESPECs) begin on next sheet:

Cable System Identification: XHHW

Description:	Single conductor Cross-linked polyethylene power and control cable for sizes No. 14 AWG and larger.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded in accordance with ASTM B8
Insulation:	XHHW-2, 90 degree C dry, 75 degree C wet, cross-linked polyethylene in accordance with ICEA S-95-658/NEMA WC70.
Jacket:	None.
Manufacturer(s):	Okonite, X-Olene; Durasheath XLP; or approved equal
Uses Permitted:	Power, control, lighting, receptacle and appliance circuits
Execution:	
Installation:	Install in accordance with Section 26 05 19.
Testing:	Test in accordance with this Section and Sections 26 05 00 and 26 08 00.

Cable System Identification: INS

Description:	Single twisted, shielded pair or triad, 18 AWG, instrumentation cable, rated for wet and dry locations.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded in accordance with ASTM B8
Insulation:	PVC/Nylon
Shield:	100 percent, 1.35 mil aluminum-Polyester tape with 20 AWG 7-strand tinned copper drain wire
Jacket:	48 mil flame-resistance polyvinylchloride
Flame Resistance:	UL 1685, ICEA T-29-520 and IEEE 1202.
Manufacturer(s):	Single Pair: BELDEN 1120A, or approved equal Single Triad: BELDEN 1121A, or approved equal.

Execution:

Installation:	Install in accordance with Section 26 05 19.
Testing:	Test in accordance with this Section and Sections 26 05 00 and 26 08 00.

SECTION 26 05 26

GROUNDING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Scope.
2. Reference Standards.
3. Quality Assurance.
4. System Requirements.
5. Sizing.
6. Submittals.
7. Products.
8. Execution.

1.2 SCOPE

A. This section specifies the system for grounding electrical distribution and utilization equipment, including but not limited to cabinets, motor frames, manholes, instrumentation, metal surfaces of process/mechanical equipment that contain energized electrical components, metal structures and buildings, outdoor metal enclosures, fences and gates.

1.3 REFERENCE STANDARDS

A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE Std 81.2-1991	Guide to Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems
NETA - ATS	Inter-National Electrical Testing Association Inc. - Acceptance Testing Specifications
NFPA 70	National Electric Code (NEC) Article 250

1.4 QUALITY ASSURANCE

A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work

B. The manufacturer shall warranty the below specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SYSTEM REQUIREMENTS

A. Provide equipment grounding conductors in all electrical raceways. The conductors shall be sized in accordance with the National Electrical Code.

B. Rebar ground connections shall be via exothermic weld or hydraulically die crimped cold weld.

1.6 SIZING

A. SIZING: The minimum size of the Equipment Grounding Conductors installed with the circuit conductors shall be per the National Electrical Code Table 250.122. The circuit grounding conductor size routed with a feeder or branch circuit conductors is as shown on the drawings.

1.7 SUBMITTALS

A. PROCEDURES: Section 01 33 00.

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained

in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

    a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

    b. Failure to include a list of the specification section deviations 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.

3. Marked product literature for ground rods, test wells, and equipment ground plate.

4. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

    a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.

    b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.

    c. Submittals are to made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

5. Grounding system test data.

PART 2 PRODUCTS

2.1 PROCESS EQUIPMENT GROUNDS

A. The contractor shall coordinate with the equipment supplier to provide an equipment ground lug and contractor provided ground cable and terminations to bond the equipment to the grounding electrode system. Ground cable shall be sized in

accordance with this specification. Provide cables, exothermic welds, hydraulic die crimp connections and equipment bolted connections as necessary.

2.2 GROUND CONDUCTORS

A. The System Ground Conductor shall be soft-drawn, bare annealed copper, concentric stranded, as specified. The minimum sizes shall be as follows, where American Wire Gage (AWG) conductor sizes are not shown or specified:

15 kV-5 kV transformers	4/0 AWG
480V switchboards	4/0 AWG
480V MCC	4/0 AWG
ATS and MTS	2/0 AWG
Cable tray	2/0 AWG
Lighting & Power panels	2 AWG
Exposed metal cabinets	2 AWG
Electrical & Process equipment	2 AWG
Buildings and enclosure	2 AWG
Fences and gates	2 AWG
Motors 25 HP to 250 HP	2 AWG
Motors 1 HP to 25 HP	6 AWG

2.3 GROUND RODS

A. Ground rods shall be copper covered steel, 3/4-inch diameter and 10-feet long. Rods shall have threaded type removable caps so that extension rods of same diameter and length may be added where necessary.

2.4 CONNECTORS

A. COMPRESSION CONNECTORS: Compression connections shall be irreversible, cast copper as manufactured by Burndy, Thomas and Betts, or approved equal.

B. BOLTED CONNECTORS: Bolted connectors shall be Burndy, O. Z. Gedney, Thomas and Betts, or approved equal.

C. EXOTHERMIC WELDED CONNECTORS: Exothermic welding products shall be Erico's Cadweld Plus system with a remotely operated battery powered electronic ignition device and moisture resistant weld metal cup for the required mold, or approved equal.

D. COLD WELDED CONNECTORS: Hydraulically die crimped cold weld connectors shall be cast copper compression cross grid type as manufactured by Burndy, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Embedded and buried ground connections shall be made by exothermic or irreversible cold weld connectors. Above grade ground connections shall be made by exothermic weld or by utilizing diamond or hexagon dies and a hand compression tool for wire sizes 2 AWG and smaller and a hydraulic pump and compression head for wire sizes 2/0 AWG and larger. Tools and dies shall be approved for this purpose; dimple compressions are not acceptable. Compression connections shall be prepared in accordance with the manufacturer's instructions. Exposed ground connections to equipment shall be made by bolted clamps unless otherwise specified. No solder shall be used in any part of the ground circuits.

B. Embedded ground cables and fittings shall be exothermically or cold weld bonded to concrete reinforcing steel. Ground wires shall also be securely attached to concrete reinforcing steel with tie wires and prevented from displacement during concrete placement.

C. Grounding conductors, which are extended beyond concrete surfaces for equipment connection, shall be extended a sufficient length to reach the final connection point without splicing. Minimum extension shall be 3 feet. Grounding conductors, which project from a concrete surface, shall be located as close as possible to a corner of the equipment pad, protected by non-metallic conduit, or terminated in a flush grounding plate. Exposed grounding conductors shall be supported by noncorrosive metallic hardware at 4-foot intervals or less. Grounding conductors for future equipment shall be terminated using a two-hole copper flush mounted grounding plate.

D. Ground conductors, except signal conductor shields, entering enclosures shall be bonded together to the enclosure if it is metallic and to metallic raceways within or terminating at the enclosure. Prior to making ground connections or bonds, the metal surface at the point of connection shall be cleaned.

E. Compression-type lugs shall be used in accordance with manufacturer’s recommendations.

F. Grounding conductor shall not be used as a system neutral.

G. Surge arresters shall be directly connected to the ground system using copper conductors, sized as specified.

H. Metallic sheaths or shields of shielded power cable shall be terminated by a copper grounding strip provided with cable connection for connection to the grounding system. Grounding strip shall be sized to withstand available fault current for specimen to be terminated.

I. Furnish an equipment grounding conductor in all conduit runs sized in accordance with the NEC.

J. Grounding system shall be provided in compliance with the NEC.

K. Metallic sheaths or shields of shielded power cable shall be terminated by a copper grounding strip provided with cable connection for connection to the grounding system.

3.2 RACEWAY GROUND

A. All service, feeder and branch circuit raceways shall contain a green insulated ground conductor sized per applicable NFPA 70 National Electrical Code (NEC) tables:

1. T250.66 - Grounding Electrode Conductor for Alternating-Current Systems or

2. T250.122 - Minimum Size Equipment Grounding Conductors for Grounding Raceways and Equipment.

B. Metallic conduits terminating at concentric knock-outs or reducing washers shall be bonded using insulated grounding bushings. Grounding bushings shall be connected to the grounding system using conductors sized in compliance with NEC.

C. Provide equipment grounding conductors in all power and control circuit raceways.

3.3 EQUPMENT AND ENCLOSURE BONDING

A. Electrical distribution and utilization equipment enclosure ground bus, motor frames, manholes, metal structures and buildings, outdoor metal enclosures, fences and gates shall be bonded to the grounding system with conductor sizes as specified.

B. Connect the conductor to the metal enclosure using a UL listed connector, where the enclosure does not contain an internal ground bus.

C. Non-electrical equipment with metallic enclosures that are located outdoor, and without a cover or a shade, shall be connected to the grounding system.

3.4 ISOLATED GROUNDING

A. An isolated ground system shall be installed where required by an equipment manufacturer. The isolated ground conductor shall have green insulation with a yellow stripe and shall be run in the same raceway as the power and neutral conductors. The isolated ground bus shall be kept isolated from neutral and grounding buses.

B. Where specifically directed by the Owner and required by an equipment manufacturer, the Contractor shall provide an additional isolated ground conductor from the service

or separately derived system to an isolated ground bus bar at each associated distribution point.

C. The neutral conductor from the ultra-isolation transformers shall be grounded only at the single point ground bus in the automatic transfer switch.

3.5 SERVICE AND SEPARATELY DERIVED SYSTEM BONDING

A. A neutral bonding jumper shall be installed in only one location for each service or separately derived system. The bonding jumper shall be located at the service source or the first immediate distribution point downstream from the source. The neutral and ground buses shall be kept isolated from each other accept where the bonding jumper is installed.

3.6 GROUNDING SYSTEM TESTS

A. The Contractor shall test the facility grounding system to determine the ground resistance. The grounding test shall be IEEE Standard 81 using the NETA Fall-of-Potential procedure. A plot of ground resistance readings for each isolated ground rod, ground mat, or ground bus shall be submitted on 8-1/2 x 11-inch size graph paper. Point-to-point resistance measurements are not acceptable.

1. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test or as recommended by IEEE Standard 81. The measurements shall be made at 10-foot intervals beginning 25 feet from the test electrode and ending 75 feet from it, in direct line between the ground rod or center of grid and the current reference electrode.

2. A grounding system that shows greater than 2-ohm resistance for the flat portion of the plotted data shall be considered inadequately grounded.

3. The Contractor shall add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurements meet the 2-ohm requirement. Additional ground rods will be paid for as extra work where the required numbers exceed that specified when authorized and approved by the Construction Manager.

4. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Scope.
2. Reference Standards.
3. Quality Assurance.
4. Submittals.
5. Products.
6. Execution.

1.2 SCOPE

A. This Section specifies requirements for design, furnishing and installation of support systems for electrical raceways, cables and enclosures.

1.3 REFERENCE STANDARDS

A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI C80.1	Rigid Steel Conduit-Zinc Coated
ASTM A48 REV A	Gray Iron Castings
ASTM F512	Smooth-Wall Polyvinylchloride Conduit and Fittings for Underground Installation
FEDSPEC WW-C-581E	Conduit, Metal, Rigid and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated

Reference	Title
FEDSPEC W-C-1094A	Conduit and Conduit Fittings, Plastic, Rigid
NEMA ICS 6	Industrial Control and Systems Enclosures
NEMA TC2	Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA TC6	PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NFPA 70	National Electrical Code (NEC)
NFPA 79	Electrical Standards for Industrial Machinery
UL 1	Flexible Metal Electrical Conduit
UL 6	Rigid Metal Electrical Conduit
UL 360	Liquid Tight Flexible Electrical Conduit
UL 651	Rigid Nonmetal Electrical Conduit

1.4 QUALITY ASSURANCE

A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work

B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

A. PROCEDURES: Section 01 33 00.

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be

provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

b. Failure to include a list of the specification section deviations 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.

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.

b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.

c. Submittals are to made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

4. Supports, seismic bracing, and other electrical system mounting elements are generally not shown on the plan drawings. Hangers, supports, seismic restraints, and other electrical system mounting elements shall be submitted in accordance 01 41 20.

PART 2 PRODUCTS

2.1 RACEWAY SUPPORTS

A. CONDUIT SUPPORTS

1. Framing channel with end caps and straps shall be provided to support groups of conduit. Individual conduit supports shall be one-hole pipe straps used with clamp backs and nesting backs where required. Material as specified herein.

2. Conduit supports for PVC coated rigid steel and PVC conduit systems shall be one-hole PVC coated rigid steel clamps or oversized stainless-steel clamps.

B. MATERIALS: Table A specifies the type of raceway supports required for each location and application.

Table A

Location	Framing Channel and Accessories	Threaded Rod, Hardware, & Fittings
Outdoor	316 Stainless Steel	316 Stainless Steel
Submerged	316 Stainless Steel	316 Stainless Steel
Headspace	316 Stainless Steel	316 Stainless Steel
Process Corrosive	316 Stainless Steel	316 Stainless Steel

2.2 EQUIPMENT SUPPORTS

A. Equipment supports shall be installed where shown on the drawings and as required to support the panels and enclosures being installed.

B. Equipment support materials shall adhere to Table A above unless specified otherwise on the drawings.

C. Equipment supports shall be installed per details in the Construction Documents.

2.3 ANCHOR BOLTS

A. Anchor bolts shall be as specified in Section 05 05 00.

PART 3 EXECUTION

3.1 INSTALLATION

A. Hangers and supports shall be installed with spacing between support points in compliance with all applicable codes.

B. The cut ends of support channels shall be smoothed and without burrs left from cutting.

END OF SECTION

SECTION 26 05 33

RACEWAYS, BOXES, AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes:

1. Scope.
2. Reference Standards.
3. Quality Assurance.
4. Submittals.
5. Products.
6. Installation.
7. Raceway Specification Sheets.

1.2 SCOPE

A. This section covers the furnishing and installation of electrical conduits, wireways, pull boxes, electrical vaults, hand holes, and fittings. Raceways shall be provided for lighting, receptacles, power, control, instrumentation, signaling and grounding systems.

1.3 REFERENCE STANDARDS

A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI C80.1	Rigid Steel Conduit-Zinc Coated
ANSI C80.3	Electrical Metallic Tubing-Zinc Coated
ASTM F512	Smooth-Wall Polyvinylchloride Conduit and Fittings for Underground Installation

FEDSPEC WW-C-581E	Conduit, Metal, Rigid and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated
FEDSPEC W-C-1094A	Conduit and Conduit Fittings, Plastic, Rigid
NEMA ICS 6	Industrial Control and Systems Enclosures
NEMA TC2	Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA TC6	PVC and ABS Plastic Utilities Duct for Underground Installation

1.4 QUALITY ASSURANCE

A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work

B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or material.

1.5 SUBMITTALS

A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

   a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

   b. Failure to include a list of the specification section deviations 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.

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

    a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.

    b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.

    c. Submittals are to made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

PART 2 PRODUCTS

2.1 RACEWAY

A. General requirements for raceway materials specified in this section are listed in the RACESPECS sheets at the end of this section. The type of raceway to be used for any given area and application shall conform to the requirements of Table A in this section.

2.2 BOXES AND FITTINGS

A. PULL BOXES AND WIRING GUTTERS: Indoor boxes above grade and in unclassified indoor areas shall be NEMA 12 with hinged doors. Similar enclosures for below grade and outdoors shall be rated NEMA 4X (Type 316 stainless steel) with hinged doors. Boxes in hazardous classified areas shall be rated for the classification, NEMA 7. Box covers shall be provided with hinged doors with quick release latches and oil resistant gaskets. Box and gutter sizes, metal thickness, and grounding shall comply with the National Electrical Code. Bolt-on junction and pull box covers are not allowed.

B. TERMINAL CABINETS: Terminal cabinets located indoors and in unclassified indoor areas shall be NEMA 12. Cabinets located below grade, outdoors, and in corrosive or damp areas shall be NEMA 4X (Type 316 stainless steel). Cabinets in hazardous classified areas shall be rated for the classification, NEMA 7. Cabinets shall be provided with hinged doors with quick release latches. Adjustable terminal strip mounting accessories shall be provided. Cabinets shall be provided with channel mounted terminal blocks rated 30 amperes, 600-volt AC. Terminals shall be No. 8 minimum strap-screw type, suitable for ring tongue or locking spade terminals. Hoffman type CHQR, or approved equal.

C. PULL/JUNCTION BOXES:

1. Indoor boxes above grade and in unclassified indoor areas shall be NEMA 12 with hinged doors. Similar enclosures for below grade and outdoors shall be rated NEMA 4X (Type 316 stainless steel) with hinged doors. Boxes in hazardous classified areas shall be rated for the classification, NEMA 7. Pull and junction boxes for use in raceway systems with conduits 1-1/4" or larger shall be hinged boxes with 2 screw driver operable or quick release latches. Minimum depth of box shall be 5.3", the minimum size shall be as shown on the drawings or as required for the application or NEC. Hoffman type CH or approved equal. For damp, below grade, outdoor, or corrosive applications provide Hoffman type CHFNFSS or approved equal.

2. For Hazardous areas provide Cast copper free aluminum box with neoprene gasketed screw on cover. Crouse-Hinds GUE, GUB, or approved equal.

2.3 RACEWAY SUPPORTS

A. All support systems for electrical systems shall be as specified in Section 26 05 29.

2.4 UNDERGROUND MARKING TAPE

A. Underground marking tape shall be for early warning protection of digging around reinforced concrete duct banks. Tape shall be low density polyethylene plastic, nominally 6 inches wide and 4 mil thickness. The plastic color shall be red. A warning shall be imprinted continuously along the length, with message reading similar to "CAUTION - STOP DIGGING - BURIED ELECTRIC LINE BELOW." Tape shall be Brady "Identoline," Services and Materials "Buried Underground Tape," Somerset (Thomas & Betts) "Protect-A-Line," or approved equal.

B. Underground marking tape for directly buried cables and conduits shall be 6-inch wide metallic lined tape with red polyethylene film on top and clear polyethylene film on the bottom. The message shall be clearly printed with black over red tape and shall read "CAUTION ELECTRIC LINE BURIED BELOW."

2.5 NAMEPLATES

A. Nameplates shall be provided for all pull and junction boxes in accordance with the requirements of Section 26 05 00. Nameplate numbering shall be as indicated on the drawings. Where no wording is specified, the Contractor shall provide the functional description of the device on the nameplate or as required by the Engineer and Owner. Any nameplates provided where the wording is not specified shall first be approved by the Engineer and Owner.

PART 3 EXECUTION

3.1 INSTALLATION:

A. Table A specifies the type of raceway required for each location and application by RACESPEC sheet. Unscheduled conduit, (i.e. lighting, convenience outlets, etc.), not shown on the drawings shall be in accordance with Table A below.

Table A		
Location	Application/Condition	RACESPEC
Outdoor	Exposed	PGRS
Concealed	Power circuits beneath slab-on-grade	PVC4
Underground	Power circuits directly buried	PVC4
Underground	Instrumentation, communications and data signals directly buried	PVC4
Nonhazardous	Final connection to equipment and light fixtures	LFS
Hazardous corrosive	Exposed	PGRS

3.2 CONDUIT

A. GENERAL:

1. The number of directional changes of a conduit shall be limited to 270 degrees in any run between pull boxes.

2. Conduit runs shall be limited to a maximum of 400 feet, less 100 feet or fraction thereof, for every 90 degrees of change in direction.

3. Provide pull and junction boxes per code. When shown on drawings, box or manhole sizes shall be considered to be minimum sizes and shall be upsized by the Contractor for ease of pulling wire or if required by NEC.

4. All threaded connections must be copper coated and tightened appropriately.

5. All underground conduit runs must be inspected by owner or owner's representative before being covered.

B. OUTDOOR CONDUIT SYSTEMS:

1. In general, Contractor shall be responsible for determining conduit routing that conforms to the specified installation requirements as shown on the drawings.

2. Conduit installation shall conform to the requirements of the RACESPEC sheets and the following specified installation requirements:

    a. Exposed conduit: Install parallel or perpendicular to structural members and surfaces. Install conduit horizontally and allow minimum headroom of 7 feet.

    b. Route two or more exposed conduits in the same general routing parallel with symmetrical bends.

    c. Maintain minimum spacing between exposed parallel conduit and piping runs in accordance with the following when the runs are greater than 30 feet:

        1) Between instrumentation and 600 VAC and less power: 12 inches

        2) Between process, gas, air and water pipes: 6 inches

    d. Space exposed conduit installed on supports not more than 10 feet apart. Space multiple conduits in parallel and use framing channel.

    e. Cap conduits or plug flush conduits during construction to prevent entrance of dirt, trash, and water. Cap or plug empty conduits designated as “future”, “spare”, or “empty” and include a pulling line accessible at both ends. Use anti-seize compound on cap and plug threads prior to installation.

    f. Determine concealed conduit stub-up locations from the manufacturer’s shop drawings. Terminate concealed conduit for future use in specified equipment.

    g. Install conduit flush with structural surfaces with galvanized couplings and plugs. Caps and plugs shall match the conduit system.

    h. Provide concealed portions of conduits for future equipment where the drawings indicate future equipment. Match the existing installation for duplicate equipment.

    i. Terminate conduits that enter enclosures with Myers hub fittings that match the NEMA rating of the enclosure.

C. UNDERGROUND CONDUIT SYSTEM: Excavation, and backfilling work shall conform to respective sections of these specifications. Underground conduit shall conform to the following requirements:

1. Underground conduit bend radius shall be not less than 1 feet minimum at vertical risers and shall be not less than NEC allowances elsewhere.

2. Where conduits are terminated underground, the conduit shall extend at least 2 feet past the concrete. Conduits shall be capped and threads protected. Steel surfaces shall be given two coats of epoxy paint.

3. Underground conduits shall have 2 feet minimum earth cover unless otherwise shown.

4. Conduits not encased in concrete and passing through walls with one side in contact with earth shall be sealed watertight with special rubber gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements (Link-seal).

5. Thoroughly swab conduits and raceways on the inside, immediately upon completion of installation.

6. Backfill duct banks with clean fill compacted to 90-percent in 6-inch lifts.

7. Separate power conduits from signal conduit within the same duct bank by 12" or greater separation where possible.

D. CONDUIT SEAL-OFF FITTINGS:

1. Conduits passing:

a. Between Class I, Division 1 area and Class I, Division 2 area; provide sealing fittings located at the boundary in accordance with NEC Article- 500.

b. From hazardous or corrosive area into a non-hazardous or non-corrosive area.

c. Install the seal-off material in the conduit seal-off fittings after inspection.

E. CONDUIT SEALING MATERIAL: Provide HYDRA-SEAL® Handi-Polyurethane-Foam or approved equal product to seal conduits and inner ducts.

1. Sealing product required features

a. Compatible with common cable jacket materials.
b. ASTM E-84 flame spread requirements and UL Classified.
c. Pre-pressurized, portable, one-component closed-cell foam sealing system.
d. Dries tack-free within 15 minutes and cures within 24 hours.
e. Reacts with applied moisture or with ambient humidity.
f. Remove over-spray with acetone and remove cured foam mechanically

2. Application Criteria:

a. Apply in ambient temperatures between 60° to 100° F.

b. Apply bead onto clean surface.

3.3 RACEWAY NUMBERING

A. Each conduit shall be provided with a number tag at each end and in each manhole, hand hole, or pull box.

3.4 RACEWAY SCHEDULE

A. GENERAL: Raceways are scheduled on the drawings.

3.5 RACESPEC SHEETS

A. The following RACESPECS are included in Paragraph 3.7.

1. FLEX
2. GRS
3. LFS
4. PGRS
5. PVC4

3.6 RACEWAY SPECIFICATION SHEETS (RACESPEC)

A. RACEWAY SPECIFICATION SHEETS (RACESPEC) – FLEX

Raceway Identification	FLEX
Description	Flexible Steel Conduit
Application	Final connection to equipment subject to vibration or adjustment.
Compliance	UL 1
Construction	Spirally wound galvanized steel strip with successive convolutions securely interlocked
Minimum size	½ inch
Fittings	Compression type
Other	FLEX shall be provided with an internal ground wire.

B. RACEWAY SPECIFICATION SHEETS (RACESPEC) – GRS

Raceway Identification	GRS
Description	Galvanized Rigid Steel Conduit (GRS).
Application	Final connection to equipment subject to vibration or adjustment.
Compliance	ANSI and UL
Finish	Hot-dip galvanized after fabrication, inside and outside. Smooth finished surfaces.
Minimum size	Unless otherwise specified, ¾ inch for exposed, 1 inch for embedded, encased, or otherwise inaccessible.
Fittings	
Locknuts, Rings, Hubs	Hot-dip galvanized insulated throat with bonding locknut or ring. The hubs shall utilize a neoprene "O" ring and provide a watertight connection. O-Z Gedney, CHM-XXT, or approved equal.
Unions	Electro-galvanized ferrous alloy type Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or approved equal. Threadless fittings are not acceptable.
Conduit Bodies	40% Oversized conduit bodies (Similar to T&B Form 8): Ferrous alloy type with screw taps for fastening covers to match the conduit system. Gaskets shall be made of neoprene.
Boxes	
Indoor	Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square.
Outdoor	Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square.
Corrosive	NEMA 4X stainless steel or nonmetallic, as specified.
Hazardous	NEMA Class 7 cast ferrous.

(contd. below)

Raceway Identification	GRS
Elbows	
¾ '' thru 1 ½''	Factory fabricated or field bent
2'' thru 6''	Factory fabricated only
Conduit Bodies (Oversized)	
¾ '' thru 4''	Malleable iron, hot-dip galvanized, unless otherwise noted. Neoprene gaskets for all access plates. Tapered threads for conduit entrances
5'' and 6''	Electro-galvanized iron or cast-iron box
Expansion Fittings	Expansion fittings in embedded runs shall be watertight with an internal bonding jumper. The expansion material shall be neoprene allowing for 3/4-inch movement in any direction
Manufacturers	Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or approved equal
Installation	Rigid steel conduit shall be made up tight and with conductive thread compound. Joints shall be made with standard couplings or threaded unions. Steel conduit shall be supported away from the structures using hot-dip galvanized malleable iron straps with nesting backs or framing channel. Conduit entering boxes shall be terminated with a threaded hub with a grounding bushing. Exposed male threads on rigid steel conduit shall be coated with zinc-rich paint.

C. RACEWAY SPECIFICATION SHEETS (RACESPEC) - LFS

Raceway Identification	LFS
Description	Liquid-tight Flexible Steel Conduit.
Application	Final connection to equipment subject to vibration or adjustment.
Compliance	UL 360.
Construction	Spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquid-tight plastic cover.
Minimum size	¾ inch, except for instruments where ½ inch is acceptable.
Fittings	Cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral O-ring seals around the conduit and box connection and insulated throat Provide forty-five and ninety degree fittings where applicable Provide PVC coated flexible conduit and fittings where the conduit system is PVC coated
Installation	Length of flexible liquid-tight conduit shall not exceed 36 inches in length. Use conductive thread compound.

D. RACEWAY SPECIFICATION SHEETS (RACESPEC) – PGRS

Raceway Identification	PGRS
Description	Rigid Steel Conduit, Corrosion-Resistant, Polyvinyl Chloride (PVC) Coated. Provide factory made and coated elbows.
Compliance	ANSI and UL. The PVC coated rigid galvanized steel conduit shall meet NEMA RN1-2005 and UL-6 PVC adhesion performance requirements.
Finish	PGRS shall be hot-dip galvanized rigid steel conduit as specified in 26 05 33-7.03 GRS, with a PVC Coating. The PVC coating shall be gray, minimum 40 mils thick, bonded to the outside and continuous over the entire length of the conduit except at the threads, and be free of blisters, bubbles, or pinholes. Thread protectors shall be used on the exposed threads of the PVC coated conduit A 2-mil coat of urethane enamel coating shall be bonded to the inside. Coating shall be free of pinholes. Bond strength shall exceed the tensile strength of the PVC coat.
Minimum size	¾ inch
Fittings	Similarly coated to the same thickness as the conduit and provided with Type 316 stainless steel hardware. Conduit and fittings shall be manufactured by the same company Conduit and fittings shall be coated by the same company. Male threads on elbows and nipples, and female threads on fittings or conduit couplings shall be protected by application of urethane coating.
Covers	PVC coated covers shall have a NEMA 4X rating and stainless-steel hardware.
Conduit Bodies	40% Oversized conduit bodies with covers as specified above.
Hubs	Hubs for connection of conduit to junction, device, or terminal boxes shall be threaded cast ferrous alloy. Hubs shall have the same PVC coating as the conduit and insulating grounding bushings. Hubs shall utilize a neoprene “O” ring and shall provide a watertight connection.

Boxes

Nonhazardous	Type FD cast ferrous with PVC coating for all device boxes and for junction boxes less than 6 inches square.
Hazardous	NEMA Class 4X stainless steel or nonmetallic for junction boxes 6 inches square and larger.
Manufacturers	Ocal Blue, Robroy Industries, Plasti-Bond, Perma-Cote, KorKap or approved equal.
Installation	Plastic coated conduit shall be made up tight, threaded, and installed using tools approved by the PVC-coated conduit manufacturer.
	Exposed conduit threads shall be covered by a plastic overlap coated and sealed per manufacturer's recommendations.
	Pipe wrenches and channel locks shall not be used for tightening plastic-coated conduits. Damaged areas shall be patched, using manufacturer's recommended material. The area to be patched shall be built up to the full thickness of the coating. Painted fittings are not acceptable.
	PVC coated conduit shall be supported away from the structure using PVC coated conduit wall hangers or PVC coated conduit mounting hardware.
	Damaged work shall be replaced.
Training	Installers shall be trained and certified in the proper installation techniques provided by the PVC-coated conduit system manufacture. Proof of certification shall be provided under paragraph 26 05 33

E. RACEWAY SPECIFICATION SHEETS (RACESPEC) – PVC4

Raceway Identification	PVC4
Description	Rigid Nonmetallic Conduit.
Application	Heavy wall thickness for direct bury, concrete encasement or surface mounting where not subject to physical damage.
Compliance	NEMA TC2, UL 651
Construction	Schedule 40, high-impact, polyvinylchloride (PVC).
Minimum size	¾ inch exposed; 1 inch embedded or encased
Fittings	PVC solvent weld type.
Boxes	
Indoor	NEMA Class 4, nonmetallic
Outdoor and corrosive	NEMA Class 4X stainless steel or nonmetallic for junction boxes 6 inches square and larger.
Manufacturers	Cantex, Allied Tube, Prime Conduit or approved equal.
Installation	PVC conduit entering fiberglass boxes or cabinets shall be secured by threaded bushings on the interior of the box and shall be terminated with a threaded male terminal adapter having a neoprene O ring. Joints shall be made with standard PVC couplings. PVC conduit shall have bell ends where terminated at walls and boxes.

END OF SECTION

SECTION 26 05 85

UTILITY COORDINATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes requirements for:

1. Coordination with the Utility companies to provide service.

2. Contractor's responsibilities for connecting to utilities and providing utility service to the facilities.

3. Descriptions of utility services required.

B. The Contractor shall coordinate with the local electric Utility for the relocation of the electrical service to the new lift station.

1. Electric Utility:

   a. Utility: Tacoma Public Utilities (TPU)
   b. Contact: John Hiloton
   c. Phone number: 253-208-4410.

2. Contractor shall coordinate with TPU for all aspects of the electrical service prior to installing any conduit or equipment. Verify all requirements of the service design and provide installation and equipment as directed by the utility.

3. Contractor to coordinate with the utility and Owner for the relocation of the existing service meter and panel with disconnect to the existing pump station for re-use for the new station.

4. Contractor to coordinate with the Owner for ordering and payment for the service relocation.

5. The Owner will be responsible for ordering and payment to the utility for the service design and related utility fees.

6. Temporary power is not currently available to the project site. Contractor shall coordinate and provide temporary power at the project site when required and necessary. If temporary power is to be provided by PUD, contractor to coordinate.

1.2 REFERENCES

A. Refer to Section 26 05 00.

1.3 DEFINITIONS

A. Refer to Section 26 05 00.

1.4 SYSTEM DESCRIPTION

A. Electrical Service:

1. Provide electrical ducts, raceways, conductors, and connections indicated on the Drawings or as required by the utility. Work and materials required for a complete electrical service shall include but not be limited to the following:

a. Electrical service conduits from the point of Electric Utility connection to the service entrance equipment.

2. Provide Electrical metering equipment per utility requirements. Coordinate, verify and provide equipment data to utility if required.

B. General:

1. Coordinate and obtain inspections and final installation approval from serving utilities and other authorities having jurisdiction.

2. Contractor shall be responsible for obtaining all electrical permits and fees associated with the electrical system as required, unless specifically listed above (i.e. electrical service).

1.5 SUBMITTALS

A. Certification:

1. Submit certification that the intended installation has been coordinated with the Utility company and Owner.

2. Certification shall include a narrative description of the Utility's requirements and points of connection and names and telephone numbers for contacts at the Utilities.

1.6 QUALITY ASSURANCE

A. Refer to Section 26 05 00.

B. Materials and equipment used in performance of electrical work shall be listed or labeled by Underwriter's Laboratories or another equivalent recognized independent testing laboratory.

C. The Contractor shall verify if the utility has a preferred approved materials list. If a list exists, the contractor shall provide the materials and equipment as listed.

1.7 PROJECT OR SITE CONDITIONS

A. Refer to Section 26 05 00.

1.8 SCHEDULING

A. General:

1. Before start of site work, make arrangements for temporary electrical service as required.

B. Electrical systems:

1. Coordinate with the Electric Utility for connection and turn-on.

2. Coordinate with the Electric Utility for disconnection and relocation of existing site service.

C. Before commencing site work, coordinate underground conduit installations with other work to eliminate conflicts and avoid interferences with other underground systems.

1. Pay special attention to the existing underground utilities as the site is very compact and has multiple utilities running through it. Contractor may need to hand dig in certain areas to ensure non-accidental contact or breakage of existing underground utilities.

PART 2 NOT USED

PART 3 EXECUTION

3.1 INSTALLATION

A. Coordinate relocation in the field with special attention to proposed fencing, retaining wall and clearance from existing transformer.

END OF SECTION

SECTION 26 32 13

DIESEL-ENGINE GENERATORS

PART 1 GENERAL

1.1 SUMMARY

A. This section expands administrative and procedural requirements for submittals for review, information, and for project closeout.

B. Section includes:

1. Scope.
2. Reference Standards.
3. Quality Assurance.
4. Submittals.
5. Product Requirements.
6. Installation.
7. Testing.

1.2 SCOPE

A. This Section includes packaged engine-generator sets suitable for use in mission critical applications with sub-base diesel tank as specified and indicated. Engine generator will be used as the Standby power source for the system, but shall be capable of providing reliable power with no run-time limitations while the primary source of power is unavailable.

B. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

C. The generator set manufacturer shall warrant all equipment provided under this section whether or not is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

D. The generator set supplier shall be responsible for complete compliance to all specification requirements for the entire on-site power supply system, including generator set(s), power switching equipment, and paralleling equipment (when used).

E. Contractor to coordinate installation of the fuel system, fuel piping, and fuel leakage detection system with the generator manufacturer per the contract drawings and the local fire marshal.

1.3 REFERENCE STANDARDS

Reference	Title
NFPA 37	Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines
NFPA 70	National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702
NFPA 110	(Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system

A. Comply with UL 2200.

1.4 QUALITY ASSURANCE

A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing equipment of types and capacities similar to those indicated for this Project and with a service center maintained by engine generator set manufacturer capable of providing training, parts, and emergency maintenance and repairs at the Project site with 24 hours maximum response time.

C. Listing and Labeling: Provide system components of types and ratings for which listing or labeling service is established and components specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

D. Comply with NFPA 70.

E. Comply with NFPA 99.

F. Comply with NFPA 704, Hazard Identification signage.

G. Engine Exhaust Emissions: Comply with applicable federal, state, and local government requirements.

1. Tier 4 emission limits generally apply for units under 75 KW.

a. Above ranges may vary depending on actual diesel engine ratings.

H. The manufacturer shall warranty the above specified equipment for 5 years from equipment start-up and commissioning to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

b. Failure to include a list of the specification section deviations 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.

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.

b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.

C. Submittals are to made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

D. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:

1. Thermal damage curve for generator.

2. Time-current characteristic curves for generator protective device.

3. Sound test data, based on a free field requirement.

E. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.

1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.

2. Wiring Diagrams: Control interconnection, Customer connections.

F. Load Calculations

1. Provide manufacturers load calculations that demonstrate the generator has been properly sized for the application.

a. Obtain load information from the one line diagram and or the load summary.

b. Develop step and load starting sequence that corresponds to the logical operation of the facility.

1) Step sequencing shall assume all hardwired and non-automated equipment starts on step one.

2) Subsequent steps shall begin with starting of largest motors first and then transition to smaller.

3) Step sequence to be confirmed by the owner and engineer.

G. Certifications:

1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for EPA, stationary emergency application.

2. Submit statement of compliance which states the proposed product(s) are seismically certified in compliance with local requirements signed and sealed by a qualified professional engineer.

H. Warranty:

1. Provide copy of warranty.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that the 24 Hours fuel tank, the Sound Attenuated enclosure, engine-generator set, and components will withstand seismic forces for the region of installation. Include the following:

1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Source quality-control test reports.

1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.

2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA 110 level 1.

3. List of factory tests to be performed on units to be shipped for this Project.

4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 10.0 deg F to 110.0 deg F.

2. Relative Humidity: 0 to 95 percent.

3. Altitude: Sea level to 1000.0 feet (110.0 m).

1.8 DELIVERY, STORAGE AND HANDLING

A. PROCEDURES: Section 01 66 00

B. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: The basis for this specification is Generac Protector Series in order to match existing units owned and maintained by the City. Alternatives will not be accepted.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and tested, engine-generator set.

B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.

1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.

C. Capacities and Characteristics:

1. Power Output Ratings: Electrical output power rating for Standby operation of not less than 30.0kW, at 80 percent lagging power factor, 120/240, three-phase, 4 wire, 60 hertz.

2. Alternator shall be capable of accepting maximum 37.5 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components. The engine-generator nameplate shall include information of the power output rating of the equipment.

D. Generator-Set Performance:

1. Steady-State Voltage Operational Bandwidth: 0.25 percent of rated output voltage from no load to full load.

2. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.

3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.

4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

5. Transient Frequency Performance: not more than 15 percent variations for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 5 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.

6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.

8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.

9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.

2.3 ENGINE

A. Fuel: Ultra Low Sulfur Diesel fuel

B. Rated Engine Speed: 1800RPM.

C. Lubrication System: The following items are mounted on engine or skid:

1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.

2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.

3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions

E. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.

1. Designed for operation on a single 120 VAC, Single phase, 60Hz power connection. Heater voltage shall be shown on the project drawings.

2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.

3. Provided with a 12VDC thermostat, installed at the engine thermostat housing

G. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control

system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.

H. Cooling System: Closed loop, liquid cooled

1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.

2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.

3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.

4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.

I. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Silencer shall have chambered construction of the critical (or better) type and shall have aluminized finish for corrosion resistance.

2. Contractor shall mount silencer so the engine does not support it weight.

3. Provide flexible exhaust connection between engine exhaust manifold and exhaust line.

4. Provide and exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine.

5. Make provisions as required for pipe expansion and contraction.

J. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.

K. Starting System: 12 or 24VDC with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.

2. Cranking Cycle: As required by NFPA 110 for level 1 systems.

3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.

4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.

5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.

6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:

a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.

d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts

that provide a battery-charger malfunction indication at system control and monitoring panel.

e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide an LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.

f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 FUEL STORAGE

A. Comply with NFPA 30.

B. Sub Base-Mounted Fuel Oil Tank: Provide a double wall secondary containment type sub base fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be UL 2085 listed and labeled in non-secure areas and UL-142 rated in areas where vandalism and physical damage are not likely. The fuel tank shall include the following features:

1. Capacity: Unit to be sized for a minimum of 24 Hours continuous operation at 100 percent rated power output.
2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank.
3. Electrical stub up(s)
4. Normal & emergency vents
5. Lockable fuel fill
6. Mechanical fuel level gauge
7. High and low level switches to indicate fuel level
8. Leak detector switch
9. Tank shall include a welded steel containment basin, sized at a minimum of 130% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
10. Fill port with overfill prevention valve (OFPV)
11. 5-gallon fill/spill dam or bucket, when not used with a remote fuel station.
12. Tank design shall meet the regional requirements and any requirements of the AHJ for the Project location

2.5 CONTROL AND MONITORING

A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.

B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.

D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.

E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:

1. AC voltmeter (3-phase, line to line and line to neutral values).

2. AC ammeter (3-phases).

3. AC frequency meter.

4. AC kW output (total and for each phase). Display shall indicate power flow direction.

5. AC kVA output (total and for each phase). Display shall indicate power flow direction.

6. AC Power factor (total and for each phase). Display shall indicate leading or lagging condition.

7. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.

8. Emergency Stop Switch: Switch shall be a red "mushroom head" pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.

9. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.

10. DC voltmeter (alternator battery charging).

11. Engine-coolant temperature gauge.

12. Engine lubricating-oil pressure gauge.

13. Running-time meter (hours).

14. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control shall adjustment of these parameters in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.) The voltage and frequency adjustment functions shall be disabled when the paralleling breaker is closed.

15. Fuel tank derangement alarm.

16. Fuel tank high-level shutdown of fuel supply alarm.

17. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR, reverse kW, over load (kW) short circuit, over current, loss of voltage reference, and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.

18. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.

19. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.

20. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.

21. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.

22. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).

F. Control Interface for Remote Monitoring

1. Provide "dry" contacts for the following conditions, as a minimum. Contacts shall be rated 2A @ 30VDC.

   a. Low Fuel
   b. Generator Run
   c. Generator Trouble

G. Remote Emergency-Stop Switch: Surface mounted, NEMA 4 weatherproof and labeled. Push button shall be protected from accidental operation.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:

1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.

2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.

3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.

4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.

5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.

6. The protective system provided shall not include an instantaneous trip function.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H

D. Temperature Rise: 125 / Class H environment.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.

G. Enclosure: Drip-proof.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

J. Subtransient Reactance: 12 percent maximum, based on the rating of the engine generator set.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Sound Attenuated Aluminum housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure. Rating of enclosure shall be no more than 70 DBA @ 23’ when operating at 100% load, as measured in a free field.

B. Construction:

1. Louvers: Equipped with bird screen to permit air circulation when engine is not running while excluding birds and rodents.

2. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance.

3. Exhaust System:

   a. Muffler Location: Within enclosure.

4. Hardware: All hardware and hinges shall be stainless steel.

5. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.

6. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.

7. Inlet ducts shall include rain hoods

C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.

   1. Louvers: Fixed-engine, cooling-air inlet and discharge.

D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 70 dBA measured at any location 7m (23') from the engine generator in a free field environment.

E. Site Provisions:

   1. Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank (when used) shall be designed to be lifted into place as a single unit, using spreader bars.

2.9 VIBRATION ISOLATION DEVICES

A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.

   1. IBC Compliance: Isolators complying with IBC requirements shall be specified in the equipment documentation, as well as the installation requirements for the unit.

2.10 FINISHES

A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.

2. Full load run.

3. Maximum power.

4. Voltage regulation.

5. Steady-state governing.

6. Single-step load pickup.

7. Simulated safety shutdowns.

8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.

B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction (AHJ). Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.

F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

H. Coordinate installation of the fuel system, fuel piping, and fuel leakage detection system with the generator manufacturer.

3.2 ON-SITE ACCEPTANCE TEST

A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system. Tests shall include:

B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.

C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two-hour full load (resistive) test, and a one-step rated load pickup test in accordance

with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.

D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.3 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

3.5 SERVICE AND SUPPORT

A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of $3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, paralleling electronics, and power transfer equipment.

B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 120 miles of the site.

C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.6 SERVICE AGREEMENT

A. The supplier shall include in the base price, a one-year service agreement. The maintenance shall be performed by factory authorized service technicians capable of servicing both the engine generator set. This agreement shall include the following:

1. Generator supplier must have an in-house rental fleet with equipment sized to back up this project site.

2. All engine maintenance as recommended by the service manual.

3. All electrical controls maintenance and calibrations as recommended by the manufacturer.

4. All auxiliary equipment as a part of the emergency systems.

5. The supplier shall guarantee emergency service.

6. All expendable maintenance items are to be included in this agreement.

7. A copy of this agreement and a schedule shall be given to the Owner at the time of his acceptance, showing what work is to be accomplished and when.

END OF SECTION

SECTION 31 13 00

TREE, STUMP, AND SHRUB REMOVAL AND TRIMMING

PART 1 GENERAL

1.1 SUMMARY

A. This section specifies general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction, as well as removal of trees identified in the Contract Documents.

1.2 DEFINITIONS

A. The Protection Zone shall be defined as the area surrounding individual trees or groups of trees to be protected during construction and is further defined by a circle concentric with each tree with a radius of 1.5 times the diameter of the drip line unless otherwise indicated.

1.3 QUALITY ASSURANCE

A. When tree removal is required, Contractor or Subcontractor providing tree removal services shall have a minimum of five (5) years of experience removing similar size trees in locations and circumstances similar to this Project.

B. When required by the Contract Documents, Contractor shall provide the services of an arborist certified by ISA, licensed in the jurisdiction where the Project is located, and shall be a current member of ASCA, or registered Consulting Arborist, as designated by ASCA.

1.4 SUBMITTALS

A. Experience in removal of trees in locations and circumstances similar to this Project.

B. Licenses, bonding, and insurance for Contractor or Subcontractor performing tree removal and/or pruning services.

C. Contractor shall provide product data for each type of product indicated.

D. Contractor shall provide a written Tree Pruning Schedule detailing scope and extent of pruning trees to remain that interfere with or are affected by construction.

E. When required by the Contract Documents or when a tree identified for protection is damaged, Contractor shall provide certification from an arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that those trees were promptly and properly treated and repaired when

damaged. Damage to trees identified for protection may include: removal of bark, significant damage to any tree roots that are approximately 10-percent in diameter of the tree trunk diameter breast height (DBH) or greater, or any other damage that results in concern for the viability of the tree.

F. Contractor shall provide documentation of existing trees and plantings indicated to remain, which shall establish preconstruction conditions that might be misconstrued as damage caused by construction activities.

1.5 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.

3. Foot traffic.

4. Erection of sheds or structures.

5. Impoundment of water.

6. Excavation or other digging, unless otherwise indicated.

7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Contractor shall not direct vehicle or equipment exhaust toward protection zones whenever possible.

C. Contractor shall prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 PRODUCTS

2.1 MATERIALS

A. Protection Zone Fencing

1. May be previously used materials when approved by the Owner.

2. Shall be plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and supported by tubular or T-shape galvanized steel posts spaced not more than 8 feet apart and shall be non-fading high-visibility orange in color.

3. Fencing height shall be four (4) feet.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Contractor shall examine the site to verify that the temporary erosion and sedimentation control measures are in place. Contractor shall verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones, including any alteration during removal of trees and/or stumps.

B. Contractor shall protect tree root systems from damaged caused by runoff, such as ponding and erosion.

C. Contractor shall mulch areas inside protection zones and other areas indicated with 4-inch average thickness of organic mulch. Do not place mulch within six (6) inches of tree trunks.

3.2 PROTECTION ZONES

A. Contractor shall install protection-zone fencing along edges of protection zones in a manner that will prevent people from easily entering the protected area.

B. Contractor shall repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by the Owner.

C. Contractor shall maintain protection-zone fencing, and any required signage, in a good condition that is acceptable to the Owner.

D. Contractor shall remove all protection-zone fencing and any required signage when construction operations are complete and equipment has been removed from the site.

3.3 TREE REMOVAL

A. Where tree canopy is within twenty (20) feet of utility lines, or a greater distance if required by regulations, Contractor shall notify each utility company attached to the poles, especially the power utility.

B. Where insufficient space is available for full tree felling, trees shall be limbed and removed in sections, using ropes and harnesses to safely lower each cut piece.

C. Contractor shall not allow limbs, tree sections, or other trimmed/cut materials to fall onto the roadway or private property.

D. Contractor shall pull a permit for any activities that may impact the public right-of-way, where not already covered by existing permits. The cost of this permit shall be included in the cost of the tree removal.

3.4 STUMP REMOVAL

A. Stumps shall be ground down a minimum of eight (8) inches below the surrounding ground surface or removed completely when required for the Work.

3.5 ROOT PRUNING

A. Contractor shall prune roots that are affected by temporary and permanent construction. Prune roots as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.

2. Temporarily support and protect roots from damage until they are permanently covered with soil.

3. Cover exposed roots with burlap and water regularly.

4. Backfill as soon as possible according to the Contract Documents.

B. Contractor shall prune roots at the edge of the Protection Zone by cleanly cutting all roots to the depth of the required excavation.

C. Contractor shall prune roots within the Protection Zone as follows:

1. Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems.

2. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

A. Contractor shall prune branches that are affected by temporary and permanent construction. Prune branches as follows:

1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. When tree(s) to be protected are inadvertently damaged, Contractor shall provide a certified arborist to review and make recommendations for repair and maintenance of the damaged tree(s).

2. Prune trees according to ANSI A300 Part 1 and the following:

a. Cut branches with sharp pruning instruments; do not break or chop.

b. Do not apply pruning paint to wounds.

3.7 REPAIR AND REPLACEMENT

A. Contractor shall repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by the Owner that includes the following:

1. Have certified arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.

2. Treat damaged trunks, limbs, and roots according to arborist's written instructions.

3. Perform repairs within 24 hours of damage.

4. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by the Owner.

3.8 DISPOSAL

A. Contractor shall remove all limbs, tree sections, or other trimmed/cut materials from the project site at the end of the same day they are trimmed/cut.

END OF SECTION

SECTION 31 23 00

EXCAVATION, FILL, AND GRADING

PART 1 GENERAL

1.1 DESCRIPTION

A. Work covered in this section includes general excavation, fill, backfill, and grading work.

1.2 SUBMITTALS

A. Submit results of aggregate sieve analysis and standard proctor tests for all granular material.

B. See Section 01 33 00.

1.3 COMMERCIAL STANDARDS

A. Reference Standards

1. References herein to the "WSDOT Standard Specifications" or simply "Standard Specifications" shall mean the Washington State Department of Transportation, Standard Specifications for Road, Bridge and Municipal Construction.

2. References herein to "AASHTO" shall mean Association of American State Highway Transportation Officials.

1.4 CLASSIFICATION OF EXCAVATION

A. Unclassified Excavation

1. Unclassified excavation is defined as all excavation, regardless of the type, character, composition, or condition of the material encountered, and shall further include all debris, junk, broken concrete, and all other material. All excavation shall be unclassified unless provided for otherwise elsewhere in these specifications.

2. Classified Excavation

a. Common Excavation

Common excavation is defined as the excavation of all material not classified as Rock Excavation.

b. Rock Excavation

1.5 QUALITY ASSURANCE

A. See Section 01 45 00.

1.6 SITE CONDITIONS

A. Quantity Survey – Contractor shall be responsible for calculations of quantities of cut and fill from existing site grades to finish grades established under this contract as indicated in the Contract Documents and shall include the cost for all excavation, fill, and grading in the total bid as specifically called out or incidental to individual bid item(s).

B. Dust Control shall meet Washington State Department of Ecology and City of Fircrest requirements. Protect persons and property from damage and discomfort caused by dust. Water as necessary and when directed by Engineer to quell dust.

C. Soil Control – Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers. See Section 31 25 00 for erosion and sedimentation control requirements.

D. Existing Underground Utilities – Protect active utilities encountered and notify persons or agencies when there is the potential to impact known utilities or when unidentified utilities are found. Remove inactive or abandoned utilities from within the project grading limits to a depth of at least twelve (12) inches below subgrade established under this contract. All abandoned piping to be plugged as approved by Engineer.

PART 2 PRODUCTS

2.1 CRUSHED SURFACING TOP COURSE

A. Provide Crushed Surfacing Top Course, or CSTC, as identified in the Contract Documents, meeting the gradation and other requirements in 9-03.9(3) of the Standard Specifications.

2.2 CRUSHED SURFACING BASE COURSE

A. Provide Crushed Surfacing Base Course, or CSBC, as identified in the Contract Documents, meeting the gradation and other requirements in 9-03.9(3) of the Standard Specifications.

2.3 GRANULAR DRAIN BACKFILL MATERIAL

A. See Section 32 32 20 for retaining wall backfill drainage materials.

2.4 SELECT NATIVE FILL

A. Not allowed on this project

2.5 IMPORTED FILL

A. Imported fill material shall consist of the materials identified on the Contract Drawings.

2.6 SPOILS

A. All excess material not suitable or not required for backfill and grading shall be hauled off site and disposed of in accordance with Washington State Department of Ecology requirements. Contractor shall make arrangements for disposal of the material at no additional cost to Owner.

PART 3 EXECUTION

3.1 GENERAL

A. Prior to work in this Section, become familiar with the site conditions. In the event discrepancies are found, notify the Engineer as to the nature, extent, and potential impacts of the differing conditions.

B. Do not allow or cause any work performed or installed to be covered up or enclosed prior to required tests and approvals. Should any work be enclosed or covered up, Contractor shall uncover the work at the Contractor's expense.

3.2 TOPSOIL STRIPPING AND SOCKPILING

A. Site within clearing limits shall be stripped of topsoil to depths approved by the Engineer, as required to obtain additional topsoil necessary to complete work indicated on plans or as specified.

B. Topsoil shall be free of sticks, large rocks, clods, and subsoils.

C. Stockpile topsoil at locations approved by the Engineer for redistribution as specified. Grade surface of stockpiles remaining over winter months to prevent ponding of water. Cover stockpile to minimize the infiltration of water. See Section 31 25 00 for erosion and sedimentation control requirements.

3.3 EXCAVATION

A. Excavate material of every nature and description to the lines and grades as indicated in the Contract Documents and/or as required for construction of the Project.

B. Provide and maintain equipment to remove and dispose of water during the course of work in this Section and keep excavations dry and free of frost or ice.

C. See Section 31 23 19 for Project dewatering. Coordinate drainage requirements with this work. Provide temporary drainage ditches as required and regrade as indicated at completion of the Project.

D. Excavated material not approved for use in the embankments or in excess of that needed to complete the Work shall be hauled off site and disposed of at no additional expense to Owner.

3.4 ROCK EXCAVATION

A. Where the bottom of the excavation encounters ledge rock and/or boulders and large stones which meet the definition of 'rock' as descried herein, said rock shall be removed to provide 12 inches of clearance on each side and below all structures, pipe, and appurtenances.

B. Excavations below subgrade in rock shall be backfilled to subgrade with approved bedding material and thoroughly compacted.

C. The use of explosives is not allowed for this project.

3.5 GRADING AND FILLING

A. General – Grading and filling operations shall not take place when weather conditions and moisture content of fill materials prevent the attainment of specified density. Vertical curves or roundings at abrupt changes in slope shall be established as approved by Engineer. Bring all graded areas to a relatively smooth, even grade, and slope by blading or dragging. Remove high spots and fill depressions.

B. For areas receiving surface structures or existing paved areas to be constructed or replaced by the Contractor or by others, such as roadways, driveways, parking lots, and sidewalks, and where not indicated on the Contract Drawings, place and compact CSTC and/or CSBC in accordance with the Standard Specifications. At least the top four (4) inches under the structure or pavement shall be CSTC.

3.6 TOPSOIL FILL

A. Scarify prepared subgrade to depth of four inches immediately prior to placing topsoil

B. Place topsoil in areas to be seeded to depths indicated, minimum depth of six inches. Topsoil shall be placed loosely unless otherwise directed and shall not be compacted. Do not place in wet or muddy conditions.

END OF SECTION

SECTION 31 23 19

DEWATERING

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes temporary dewatering and surface water control systems for open excavations and utility trenches.

1.2 SUBMITTALS

A. Dewatering Plan:

1. Descriptions of proposed groundwater and surface water control facilities including, bot not limited to equipment; methods; standby equipment and power supply; pollution control facilities; discharge locations to be utilized; and provisions for immediate temporary water supply as required by this Section.

2. Plan to be reviewed by the Engineer prior to the beginning of construction activities requiring dewatering. Review by the Engineer of the design shall not be construed as a detailed analysis of the adequacy of the dewatering system, nor shall any provisions of the above requirements be construed as relieving the Contractor of its overall responsibility and liability for the work.

1.3 DEFINITIONS

A. Dewatering includes the following:

1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations, trenches, tunnels, and /or shafts.

2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations, trenches, tunnels, and /or shafts.

3. Disposing of removed water.

B. Surface Water Control: Removal of surface water within open excavations.

1.4 QUALITY CONTROL

A. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.

B. Provide all labor, materials, and equipment necessary to dewater trench and structure excavations, in accordance with the requirements of the Contract Documents.

C. Secure all necessary permits to complete the requirements of this Section.

D. Control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.

E. Where the critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement which may develop.

1. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the Contractor.

2. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Standby pumping equipment shall be maintained on the jobsite.

PART 3 EXECUTION

3.1 DEWATERING

A. Provide all equipment necessary for dewatering.

1. Have on hand, at all times, sufficient pumping equipment and machinery in good working condition.

2. Have available, at all times, competent workers for the operation of the pumping equipment.

3. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.

B. Dewatering for structures and pipelines shall commence when groundwater is first encountered, and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.

C. Site Grading:

1. At all times, site grading shall promote drainage.

2. Surface runoff shall be diverted from excavations.

3. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.

D. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.

E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock.

F. Maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.

G. Flotation shall be prevented by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.

H. Dispose of water from the work in a suitable manner without damage to the environment or adjacent property. No water shall be drained into work built or under construction without prior consent of the Engineer. Water shall be filtered using an approved method to remove sand and fine sized soil particles before disposal into any drainage system.

I. All water discharges from dewatering work shall meet the stormwater quality standards of the State of Washington per WAC 173-201A-200. Turbidity shall not exceed 5 NTU over background NTU. The Contractor is responsible for using all means and equipment necessary to achieve these State standards.

J. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.

K. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the work and all costs thereof shall be included in the various contract prices in the bid forms.

L. Open and cased sumps shall not be used as primary dewatering for excavations deeper than three (3) feet below the static water table.

3.2 REMOVAL OF DEWATERING SYSTEMS

A. Removal of dewatering systems shall be performed in a manner that does not disturb or damage adjacent new or existing structures or utilities. Fill and compact all voids immediately with specified backfill material.

B. All damage to property resulting from removal shall be promptly repaired at no cost to the Owner. The Engineer shall be the sole judge as to the extent and determination of the methods and materials for repair.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the work necessary for temporary erosion control during execution of the Work.

1.2 QUALITY ASSURANCE

A. Installations that do not conform to the requirements contained herein shall be removed from the Project and replaced by the Contractor without additional cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS

A. Silt fence, inlet protection, plastic covering, street cleaning, seeding, fertilizing and mulching shall be in accordance with the Contract Documents and the Standard Specifications.

PART 3 EXECUTION

3.1 SYSTEM INSTALLATION

A. Silt fence, inlet protection, plastic covering, street cleaning, seeding, fertilizing and mulching shall be installed in accordance with the Contract Documents and the Standard Specifications.

B. The Contractor shall install silt fence on the downhill side of all open trenches and disturbed areas to prevent the migration of soil materials due to construction activities and as directed by the Engineer.

C. The Contractor shall install inlet protection on stormwater catch basins and manholes within and adjacent to the construction site and as directed by the Engineer.

D. Disturbed surface stabilization, consisting of plastic covering, street cleaning, fertilizing, and mulching shall be applied to areas where surficial soil is exposed for more than 4 days during the period between October 1st and April 1st or as directed by the Engineer to address wet weather impacts.

3.2 SYSTEM MAINTENANCE

A. Contractor shall clean, repair, and replace erosion and sedimentation control system components as required throughout Project to maintain required system performance.

3.3 SYSTEM REMOVAL

A. At the conclusion of the Project, Contractor shall remove all remaining erosion and sedimentation control system components.

END OF SECTION

SECTION 31 31 13

CHAIN LINK FENCE AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. This Section covers all work necessary to construct new chain link fencing and gates as shown on the Drawings or specified elsewhere. All fences and gates shall be furnished with top and bottom rails and knuckled periphery edges.

1.2 REFERENCES

A. ASTM A392 Specification for Zin-Coated Steel Chain Link Fence Fabric

B. ASTM A780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings

C. ASTM F552 Standard Terminology Relating to Chain Link Fencing

D. ASTM F567 Standard Practice for Installation of Chain Link Fence

E. ASTM F626 Specification for Fence Fittings

F. ASTM F900 Specification for Industrial and Commercial Swing Gates

G. ASTM F1043 Specification for Strength and Protective Coatings of Steel Industrial Chain Link Fence Framework

H. ASTM F1083 Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

1.3 SUBMITTALS

A. In accordance with the requirements of 01 33 00 – Submittal Procedures, submit shop drawings for fencing and gates, including plan layout and details illustrating fence height, location, and sizes of posts, rails, braces, gates and footings, appurtenances, hardware list, and erection procedures. Submit samples of the materials (e.g. fabric, wire, color, and accessories) if requested by the Owner.

1.4 QUALITY ASSURANCE

A. Manufacturer shall have at least five (5) years' experience specializing in manufacturing chain link fence products.

B. The fence contractor shall have at least five (5) years' experience installing similar projects in accordance with ASTM F567.

C. Provide each type of fencing and gate as a complete unit produced by a single manufacturer, including necessary erection accessories, fittings and fastenings. Requirements stated herein take precedence.

PART 2 PRODUCTS

2.1 CHAIN LINK FABRIC

A. Steel Chain Link Fabric: Height as indicated on drawings. Maximum 2-inch mesh opening size, 9-gauge core wire. Fabric shall be hot dip galvanized and coated with vinyl, if indicated on the Drawings.

2.2 ROUND STEEL PIPE FENCE FRAMEWORK

A. Round steel pipe and rail: Schedule 40 standard weight pipe, in accordance with ASTM F1083, 1.8 oz/ft^2 (550 g/m^2) hot dip galvanized zinc exterior and 1.8 oz/ft^2 (550 g/m^2) hot dop galvanized zinc interior coating. Minimum steel yield strength of 30,000 psi (205 MPa). Materials shall be coated with vinyl, if indicated on the Drawings, to match the chain link fabric.

B. Unless otherwise indicated on the drawings, post and rail sizes shall follow the table below.

Item	Fence Height	Outside Diameter (inches)	F1083 Schedule 40 weight (lb/ft)
Line Posts	Up to 6 feet	1.900	2.72
	Over 6 to 8 feet	2.375	3.65
	Over 8 to 12 feet	2.875	5.79
	Over 12 to 16 feet	4.000	9.11
Terminal Posts	Up to 6 feet	2.375	3.65
	Over 6 to 8 feet	2.875	5.79
	Over 8 to 12 feet	4.000	9.11
	Over 12 to 16 feet	6.625	18.97
Rails		1.660	2.27

2.3 TENSION WIRE

A. Metallic Coated Steel Marcelled Tension Wire: 7-gauge core (0.177 inch) marcelled wire complying with ASTM A824. Match coating type to that of chain link fabric.

2.4 FITTINGS

A. Tension and Brace Bands: Galvanized pressed steel complying with ASTM F626, minimum steel thickness of 12 gauge (0.105 inch), minimum width of ¾ inch, and minimum zinc coating of 1.20 oz/ft^2. Secure bands with 5/16 inch galvanized steel carriage bolts.

B. Terminal Post Caps, Line Post Loop Tops, Rail and Brace Ends, Boulevard Clamps, Rail Sleeves: In compliance with ASTM F626, pressed steel galvanized after fabrication, having a minimum zinc coating of 1.20 oz/ft^2.

C. Truss Rod Assembly: In compliance with ASTM F626, 3/8 inch or 5/16 inch diameter steel truss rod with a pressed steel tightener, minimum zinc coating of 1.2 oz/ft^2, assembly capable of withstanding a tension of 2,000 lbs.

D. Tension Bars: In compliance with ASTM F626. Galvanized steel one-piece length, 2 inches less than the fabric height. Minimum zinc coating 1.2 oz/ft^2.

2.5 TIE WIRE AND HOG RINGS

A. Tie wire and hog rings shall be 9 gauge core aluminum alloy per ASTM F626.

2.6 SWING GATES

A. Swing Gates: Galvanized steel pipe welded fabrication in compliance with ASTM F900. Gate frame members 1.900 inch outside diameter. Frame members spaced no greater than eight (8) feet apart vertically and horizontally. Welded joints protected by applying zinc-rich paint in accordance with ASTM Practice A780. Positive locking gate latch, pressed steel galvanized after fabrication. Galvanized malleable iron or heavy gauge pressed steel post and frame hinges. Provide lockable drop bar and gate holdbacks with double gates. Match gate fabric to that of the fence system. Gateposts per ASTM F1083 schedule 40 galvanized steel pipe. Select the gatepost diameter from the following table.

Gate fabric height up to and including 6 feet		
Gate leaf width	Post Outside Diameter (inches)	Weight (lb/ft)
Up to 4 feet	2.375	3.65
Over 4 to 10 feet	2.875	5.79
Over 10 to 18 feet	4.000	9.11
Gate fabric height over 6 to 12 feet		
Gate leaf width	Post Outside Diameter (inches)	Weight (lb/ft)
Up to 6 feet	2.875	5.79
Over 6 to 12 feet	4.000	9.11
Over 12 to 18 feet	6.625	18.97
Over 18 to 24 feet	8.625	28.58

2.7 CONCRETE

A. Concrete for post footings shall have a minimum 28-day compressive strength of 2,500 psi.

PART 3 EXECUTION

3.1 PRE-INSTALLATION

A. Contractor shall stake fence alignment, as indicated on the Drawings, and meet with Owner at the site to confirm final layout prior to starting installation of any fence or gate components.

B. Clearing: Entire fence line shall be cleared prior to starting construction to accommodate final line and grade. See Drawings for alignment and grade.

3.2 FRAMEWORK INSTALLATION

A. Posts: Posts shall be set plumb in concrete footings in accordance with ASTM F567. Unless otherwise indicated on the Drawings, the minimum footing depth shall be 24 inches plus an addition 3 inches of depth for each foot of fence height over four (4) feet. The minimum footing diameter shall be four times the largest cross section of the post up to a 4.00-inch diameter post and shall be three times the largest cross section for posts larger than 4.00 inches in diameter. Top of concrete footing to be at grade,

crowned to shed water away from the post. Line posts shall be installed at intervals not exceeding ten (10) feet on center.

B. Top Rail: When indicated, install 21-foot lengths of rail continuous through the line post or barb arm loop top. Splice rail using top rail sleeves, minimum 6-inches long. Rail shall be secured to the terminal post by a brace band and rail end. Bottom rail or intermediate rail shall be field cut and secured to the line posts using boulevard clamps or brace band with rail end.

C. Terminal Posts: End, corner, pull, and gate posts shall be braced and trussed for fence 6 feet tall and higher and for fences 5 feet in height and higher if there is no top rail. The horizontal brace rail and diagonal truss rod shall be installed in accordance with ASTM F567.

D. Tension Wire: When indicated, the tension wire shall be installed four (4) inches up from the bottom of the fabric. Fences without top rail shall have a tension wire installed four (4) inches down from the top of the fabric. Tension wire to be stretched taut, independently and prior to the fabric, between the terminal posts and secured to the terminal post using a brace band. Secure the tension wire to each line post with a tie wire. Install the top tension wire through the barb arm loop for fences having barbed wire and no top rail.

3.3 CHAIN LINK FABRIC INSTALLATION

A. Chain Link Fabric: Install fabric to outside of the framework, maintaining a ground clearance of no more than two (2) inches. Attach fabric to the terminal post by threading the tension bar through the fabric; secure the tension bar to the terminal post with tension bands and 5/16-inch carriage bolts spaced no greater than 12-cinches on center. For small mesh fabric less than 1-inch, attach to terminal post by sandwiching the mesh between the post and a vertical 2-inch wide by 3/16-inch galvanized steel strap using carriage bolts, bolted through the bar, mesh, and post spaced 15-inches on center. Chain link fabric to be stretched taut, free of sag. Fabric to be secured to the line post with tie wires spaced no greater than 12 inches on center and to horizontal rail spaced no greater than 18 inches on center. Secure the fabric to the tension wire by crimping hogs rings around a fabric wire picket and tension wire.

3.4 GATE INSTALLATION

A. Swing Gates: Installation of swing gates and gateposts in compliance with ASTM F567. Direction of swing shall be as indicated on the Drawings. Gates shall be plumb in the closed position, having a bottom clearance of three (3) inches, grade permitting. Hinge and latch offset opening space shall be no greater than three (3) inches in the closed position. Double gate drop bar receivers shall be set in a concrete footing, minimum 6-inch diameter and 24 inches deep. Gate leave holdbacks shall be installed for all double gates.

3.5 NUTS AND BOLTS

A. Bolts: Carriage bolts used for fittings shall be installed with the head on the secure side of the fence. All bolts shall be peened over to prevent removal of the nut.

END OF SECTION

SECTION 32 32 15

PRECAST MODULAR BLOCK GRAVITY RETAINING WALL

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes furnishing all materials, labor, tools, and equipment necessary for the design and construction of a precast concrete modular block (PMB) gravity retaining wall without geosynthetic reinforcement.

1.2 DEFINITIONS

A. Precast Modular Block (PMB) Unit – machine placed, "wet cast" concrete modular block retaining wall facing unit.

B. Geotextile – a geosynthetic fabric manufactured for use as a separation and filtration medium between dissimilar soil materials.

C. Drainage Aggregate – clean, crushed stone placed within and immediately behind the precast modular block units to facilitate drainage and reduce compaction requirements immediately adjacent to and behind the precast modular block units.

D. Unit Core Fill – clean, crushed stone placed within the hollow vertical core of a precast modular block unit. Typically, the same material used for drainage aggregate as defined above.

E. Foundation Zone – soil zone immediately beneath the leveling pad.

F. Retained Zone – soil zone immediately behind the drainage aggregate and wall infill for wall sections designed as modular gravity structures.

G. Leveling Pad – hard, flat surface upon which the bottom course of precast modular blocks are placed. The leveling pad may be constructed with crushed stone or cast-in-place concrete. A leveling pad is not a structural footing.

H. Wall Infill – the material placed and compacted between the drainage aggregate and the excavated soil face in retaining wall sections designed as modular gravity structures.

1.3 SUBMITTALS

A. Product Data – Contractor shall submit the retaining wall product submittal package to the Owner for review and approval. The submittal package shall include technical specifications and product data from the manufacturer for the following:

1. Precast Modular Block System brochure

2. Precast Modular Block concrete test results specified in Part 2 of this Section, as follows:

    a. 28-day compressive strength

    b. Air content

    c. Slump or Slump Flow (as applicable)

3. Drainage Pipe

4. Geotextile

B. Installer Qualification Data – Contractor shall submit the qualifications of the Retaining Wall Installation Contractor (RWIC)

C. Retaining Wall Design Calculations and Construction Shop Drawings – Contractor shall submit construction shop drawings and the supporting structural calculations report to the Owner for review and approval. Submittal shall include:

1. Signed, sealed, and dated drawings and engineering calculations prepared in accordance with the Contract Documents.

2. Qualifications Statement of Experience of the Retaining Wall Design Engineer (RWDE).

3. Certificate of Professional Liability Insurance of the RWDE verifying the minimum coverage limits of $1 million per claim and $1 million aggregate.

1.4 RETAINING WALL DESIGN AND SHOP DRAWING PREPARATION

A. Design of the precast modular block retaining wall shall satisfy the requirements of the Contract Documents. Where local design or building code requirements exceed these specifications, the local requirements shall also be satisfied.

B. The RWDE shall note any exceptions to the requirements of this Section by listing them on the submittal cover sheet.

C. Allowable bearing pressure requirements for each retaining wall shall be clearly shown on the construction drawings.

D. Global Stability – Overall (global) stability shall include the following recommended minimum factors of safety:

1. Normal service (static) 1.5

2. Seismic 1.1

E. Seismic Stability – Seismic loading shall be evaluated in accordance with AASHTO Load and Resistance Factor Design (LRFD) methodology.

1.5 QUALITY ASSURANCE

A. RWIC Qualifications – In order to demonstrate basic competence in the construction of precast modular block walls, the RWIC shall submit documentation of compliance with the following:

1. Experience

a. Construction experience with a minimum of 3,000 square feet face area of the proposed precast modular block retaining wall system.

b. Construction of at least three (3) precast modular block (large block) retaining wall structures within the past three (3) years.

2. RWIC experience documentation for each qualifying project shall include:

a. Project name and location

b. Date (month and year) of construction completion

c. Contact information of Owner or General Contractor

d. Type (trade name) of precast modular block system used

e. Maximum height of the wall constructed

f. Face area of the wall constructed

B. RWDE Qualifications and Statement of Experience

1. RWDE shall be a professional engineer, licensed to provide engineering services in the State of Washington, and legally allowed to complete the design of the precast modular block gravity retaining wall.

1.6 DELIVERY, STORAGE, AND HANDLING

A. The RWIC shall inspect the materials upon delivery to ensure that the proper type, grade, and color of materials have been delivered.

B. The RWIC shall store and handle all materials in accordance with the manufacturer's recommendations.

C. Geosynthetics – All geosynthetic materials shall be stored off the ground and protected from precipitation, sunlight, dirt, and physical damage.

D. Precast Modular Blocks – Precast modular blocks shall be stored in an area with positive drainage away from the blocks. Blocks shall not be stacked more than three (3) units high.

E. Drainage Aggregate and Backfill Stockpiles

1. Drainage aggregate or backfill material shall not be piled over unstable slopes or areas of the project site with buried utilities.

2. Drainage aggregate material shall not be staged where it may become mixed with or contaminated by poor draining, fine-grained soils such as clay or silt.

PART 2 PRODUCTS

2.1 PRECAST MODULAR BLOCK RETAINING WALL UNITS

A. All units shall be wet-cast precast modular retaining wall units conforming to ASTM C1776.

B. All units for the project shall be obtained from the same manufacturer. The manufacturer shall be licensed and authorized to produce the retaining wall units by the precast modular block system patent holder/licensor and shall document compliance with the published quality control standards of the proprietary precast modular block system licensor for the previous three (3) years, or the total time the manufacturer has been licensed, whichever is less.

C. Concrete used in the production of the precast modular block units shall be first-purpose, fresh concrete. It shall not consist of returned, reconstituted, surplus, or waste concrete. It shall be an original production mix meeting the requirements of ASTM C94 and exhibit the properties:

Minimum 28-day compressive strength	4,000 psi
Maximum water-to-cement ratio	0.45
Nominal Max Aggregate Size	1 inch
Aggregate Class Designation	3M
Air Content	4.5% +/- 1.5%
Max Water-Soluble Chloride Ion in Concrete	0.15 percent by cement weight

Maximum Chloride as CL- Concentration in Mixing Water	1000 parts per million
Slump (conventional concrete)	5 inches +/- 1.5 inches
Slump Flow (self-consolidating concrete)	18 inches – 32 inches

D. Each concrete block shall be cast in a single continuous pour without cold joints. With the exception of half-block units, corner units, and other special application units, the precast modular block units shall conform to the nominal dimensions listed in the table below and be produced to the dimensional tolerances shown.

E. With the exception of half-block units, corner units, and other special application units, the precast modular block units shall have two (2), circular dome shear knobs that fully index into a continuous semi-cylindrical shear channel in the bottom of the block course above. The blocks shall be interlocked sufficiently to resist a minimum of 1.5 times the induced shear load.

F. Horizontal setback facing batter shall be the minimum required to achieve resistance to the imposed loads and within the spatial parameters indicated on the Contract Drawings.

G. The precast modular block unit face texture shall be selected by the Owner from the available range of textures available from the precast modular block manufacturer.

H. The block color shall be selected by the Owner from the available range of colors available from the precast modular block manufacturer.

I. All precast modular block units shall be sound and free of cracks or other defects that would interfere with the proper installation of the unit, impair the strength or performance of the constructed wall. PMB units to be used in exposed wall construction shall not exhibit chips or cracks in the exposed face or faces of the unit. Chips smaller than 1.5-inch in its largest dimension and cracks not wider than 0.012-inch and not longer than 25% of the nominal height of the PMB unit shall be permitted. PMB units with bug holes in the exposed architectural face larger than 0.5-inch in its largest dimension will not be allowed. Contractor may fill bug holes smaller than 0.5-inch may be filled with a cement-slurry, at the request of the Owner. PMB units that exhibit cracks that are continuous through any solid element of the PMB unit shall not be incorporated into the work regardless of the width or length of the crack.

J. Basis of Design Manufacturer: Redi-Rock Retaining Wall Systems, as licensed by Redi-Rock International, LLC.

2.2 GEOTEXTILE

A. Nonwoven geotextile fabric shall be placed as indicated on the retaining wall construction shop drawings. Additionally, the nonwoven geotextile fabric shall be placed in the v-shaped vertical joint between adjacent blocks on the same course.

B. Approved geotextiles:

1. Mirafi 140N
2. Propex Geotex 451
3. Skaps GT-142
4. Thrace-Linq 140EX
5. Carthage Mills FX-40HS
6. Stratatex ST 142

2.3 DRAINAGE AGGREGATE AND WALL INFILL

A. Drainage aggregate (and wall infill for retaining walls designed as modular gravity structures) shall be a durable crushed stone conforming to No. 57 size per ASTM C33 with the following particle-size distribution requirements per ASTM D6913:

US Standard Sieve Size	% Passing
1-1/2”	100
1”	95-100
½”	25-60
No. 4	0-10
No. 8	0-5

2.4 LEVELING PAD

A. The precast modular block units shall be placed on a leveling pad constructed from crushed stone or unreinforced concrete.

B. Crushed stone used for construction of a granular leveling pad shall meet the requirements of Crushed Surfacing Top Course (CSTC) in the WSDOT Standard Specifications.

C. Concrete used for construction of an unreinforced concrete leveling pad shall satisfy the criteria for AASHTO Class B. The concrete should be cured a minimum of 12 hours prior to placement of the precast modular block wall retaining units and exhibit a minimum 28-day compressive strength of 2,500 psi.

2.5 DRAINAGE

A. Drainage Pipe

1. Drainage collection pipe shall be 3-inch diameter, 3-hole perforated HDPE pipe with a minimum pipe stiffness of 22 psi per ASTM D2412.

2. The drainage pipe shall be manufactured in accordance with ASTM D1248 for HDPE pipe and fittings.

B. Approved Drainage Pipe Products:

1. ADS 3000 Triple Wall pipe as manufactured by Advanced Drainage Systems.

PART 3 EXECUTION

3.1 GENERAL

A. All work shall be performed in accordance with OSHA, State, and local safety standards, state and local building codes, and manufacturer's requirements.

3.2 PREPARATION

A. Excavation

1. Contractor shall excavate to the lines and grades required for construction of the precast modular block retaining wall as shown on the construction drawings, minimizing any over-excavation. Excavation support, if required, shall be the responsibility of the Contractor.

2. Over-excavated soil shall be replaced with Ballast aggregate, in accordance with the WSDOT Standard Specifications.

B. Foundation Preparation

1. Following excavation to the subgrade, below the leveling pad, the subgrade shall be compacted and proof-rolled to demonstrate no pumping of soils. In the event that pumping occurs, material shall be removed at the direction of the Engineer and replaced with Ballast aggregate prior to placing the leveling pad.

C. Leveling Pad

1. The leveling pad shall be constructed to provide a level, hard surface on which to place the first course of precast modular block units. Unless otherwise indicated on the Contract Drawings, the leveling pad shall be six (6) inches thick and extend six (6) inches beyond the limits of the block in all directions.

2. Crushed Stone Leveling Pad – Crushed stone shall be Crushed Surfacing Top Course (CSTC) and be placed and compacted according to the WSDOT Standard Specifications.

3. Unreinforced Concrete Leveling Pad – The concrete shall be placed in the same dimensions as those required for the crushed stone leveling pad. Contractor shall erect forms, as required, to ensure the accurate placement of the concrete leveling pad.

3.3 PRECAST MODULAR BLOCK WALL SYSTEM INSTALLATION

A. The precast modular block structure shall be constructed in accordance with the Contract Documents and the recommendations of the retaining wall system component manufacturers. Where conflicts exist between the manufacturer's recommendations and these specifications, these specifications shall prevail unless otherwise approved in writing by the Engineer.

B. Drainage components – Pipe, geotextile, and drainage aggregate shall be installed as indicated on the Contract Drawings.

C. Precast Modular Block Installation

1. The first course of block units shall be placed with the front face edges tightly abutted together on adjacent blocks, on the prepared leveling pad at the locations and elevations indicated on the Contract Drawings. Contractor shall take special care to ensure that the bottom course of block units are in full contact with the leveling pad, are set level and true, and are properly aligned according to the locations indicated on the Contract Drawings.

2. Backfill shall be placed in front of the bottom course of blocks prior to placement of subsequent block courses. Nonwoven geotextile fabric shall be placed in the v-shaped vertical joints between adjacent blocks and extend to a minimum distance of 12 inches behind the block unit.

3. Prior to backfilling above the leveling pad, drain pipe shall be placed and bedded with drainage aggregate, as indicated in the Contract Drawings.

4. Drainage aggregate shall be placed in 9-inch maximum lifts and compacted by a minimum of three (3) passes of a vibratory plate compactor. In the case of the initial backfill and pipe zone material, the drainage aggregate shall be hand-compacted

on either side of the drainage pipe and nine (9) inches of drainage aggregate shall be placed over the top of the pipe prior to use of the plate compactor.

5. Unit core fill shall be placed in the precast modular block unit vertical core slot. The core fill shall completely fill the slot to the level of the top of the block unit. The top of the block unit shall be broom-cleaned prior to the placement of subsequent block courses. No additional courses of precast modular blocks may be stacked before the unit core fill is installed in the blocks on the course below.

6. Nonwoven geotextile fabric shall be placed between the drainage aggregate and the retained soil, as indicated on the Contract Drawings.

7. Subsequent courses of block units shall be installed with a running bond (approximately half block horizontal course-to-course offset). With the exception of 90-degree corner units, the shear channel of the upper block shall be fully engaged with the shear knobs of the block course below. The upper block course shall be pushed forward to fully engage the interface shear key between the blocks and to ensure consistent face batter and wall alignment. Drainage aggregate, unit core fill, geotextile, and properly compacted backfill shall be complete and in-place for each course of block units before the next course of blocks is stacked.

8. The elevation of retained soil fill shall not be less than one (1) block course below the elevation of the retained backfill throughout the construction of the retaining wall.

9. If included as part of the precast modular block wall design, cap units shall be secured with an appropriate construction adhesive in accordance with the manufacturer's recommendations.

D. Construction Tolerance – Allowable construction tolerance of the retaining wall shall be as follows:

1. Deviation from the design batter and horizontal alignment, when measured along a 10-foot straight wall section, shall not exceed ¾-inch.

2. Deviation from the overall design batter shall not exceed ½-inch per 10 feet of wall height.

3. The maximum allowable offset (horizontal bulge) of the face in any precast modular block joint shall be ½-inch.

4. The base of the precast modular block wall excavation shall be within two (2) inches location indicated on the Contract Drawings.

5. Differential vertical settlement of the face shall not exceed ½-inch along any 10 feet of wall length.

6. The maximum allowable vertical displacement of the face in any precast modular block joint shall be ½-inch.

3.4 WALL INFILL AND BACKFILL PLACEMENT

A. Backfill material placed immediately behind the drainage aggregate shall be compacted to 95% of the maximum dry density at +/- 2% optimum moisture content per ASTM D698 standard proctor or 85% relative density per ASTM D4254.

B. Compaction within three (3) feet of the back of the precast modular blocks should be accomplished with walk-behind compactors. Compaction in this zone shall be within 95% of the maximum dry density as measured in accordance with ASTM D1557 modified proctor or 80% relative density per ASTM D4254. Heavy equipment should not be operated within three (3) feet of the back of the precast modular blocks.

C. Backfill material shall be installed in lifts that do not exceed a thickness of 9 inches.

D. At the end of each work date, Contractor shall grade the surface of the last lift of the granular wall infill to a 3% +/- 1% slope away from the precast modular block wall face and compact it.

E. Contractor shall protect the precast modular block wall structure against surface water runoff at all times through the use of berms, diversion ditches, silt fence, temporary drains, and/or any other necessary measures to prevent soil staining of the wall face, scour of the retaining wall foundation, or erosion of the reinforced backfill or wall infill.

3.5 COMPLETION

A. For walls supporting unpaved areas, a minimum of 12 inches of compacted, low-permeability fill shall be placed over the drainage aggregate, with the geotextile fabric separating the two materials. The adjacent retained soil shall be graded to prevent ponding of water behind the completed retaining wall.

B. Where final slopes are 5H:1V or steeper, Contractor shall place appropriate erosion control measures along and adjacent to wall, as required to prevent the migration of materials or sediment. Slopes shall be immediately seeded and protected to establish vegetation.

END OF SECTION

SECTION 33 05 16

PRECAST CONCRETE UTILITY STRUCTURES

PART 1 GENERAL

1.1 SUMMARY

A. This Section covers the furnishing and installation of precast concrete vaults, manholes, and wet wells.

B. The drawings may identify precast vaults by manufacturer and model number. This information is provided for dimensional information only. The Contractor shall provide precast items in accordance with these specifications.

C. The Contractor shall construct all precast items as required in the Contract Documents, including all appurtenances necessary to make a complete installation.

D. This section does not include prestressed or cast-in-place concrete items.

1.2 CODES AND STANDARDS

Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified.

A. General: The latest edition of all specifications, codes, and standards listed herein shall be used.

B. Codes: All design and construction shall meet the requirements of the current Building Code, except where local codes or the Contract Documents are more restrictive.

C. Commercial Standards:

ACI 301	Specifications for Structural Concrete for Buildings
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
ASTM C150	Specification for Portland Cement
ASTM A48	Specification for Gray Iron Castings
ASTM C478	Precast Reinforced Manhole Sections

ASTM C923 Resilient Connectors between Reinforced Manhole Structures and Pipes

1.3 SUBMITTALS

A. The Contractor shall submit design calculations and shop drawings for all precast concrete items. Submitted drawings hall show all dimensions, location and type of lifting inserts, details of reinforcement, connection embeds, joints, covers or hatches, ladders, and grating in accordance with the Contract Documents.

B. Contractor shall submit design calculations stamped by a professional engineer registered in the State where the Project is located. These calculations may include but are not necessarily limited to calculations demonstrating the required loading(s) on the precast concrete structures.

C. Contractor shall also submit a list of the design criteria used by the manufacturer for each precast item.

1.4 QUALITY ASSURANCE

A. Quality assurance shall be in accordance with the codes and standards identified in this Specification.

1.5 MEASURMENT AND PAYMENT

A. See Specification 01 21 00

PART 2 PRODUCTS

2.1 GENERAL

A. The design and construction of all precast items shall be in accordance with the recommendations and requirements of ACI 301, ACI 315, and ACI 318.

2.2 PRECAST CONCRETE WET WELLS

A. Precast concrete wet well sections, transition sections, flat top slabs, and adjusting rings shall conform to ASTM C478 and shall have a minimum 4,000 psi compressive strength at 28 days. Minimum wall thickness shall be seven (7) inches. Reinforcing in transition sections shall be equal to that specified for wall sections of the larger diameter concrete.

B. Precast wet well sections shall consist of circular sections in standard nominal inside diameters ranging from 48 inches in diameter to 144 inches in diameter. Heights of

sections shall be in multiples of 12 inches. Diameter and types shall be as indicated on the Plans.

C. Openings for connecting pipes in riser sections, bottom riser sections, and integral base sections, and for access in flat slabs shall be preformed by the manufacturer. No openings shall be made within six (6) inches of a wet well joint.

D. Top slab shall be designed for H-20 loading and shall be a minimum of 12 inches thick.

E. Provide access hatches as shown on the drawings and as specified in Section 05 50 00. Access hatches shall be cast into the top slab. The required penetration for the access hatch shall be included as part of the top slab design.

2.3 ACCESS HATCH AND LID

A. Unless noted otherwise on the Contract Documents, precast concrete structures shall have concrete top slabs with access openings identified on the Plans. Lids shall have lifting holes. When leveling bolts are used to set the upper section(s), Contractor shall ensure that the load from the top slab is transferred through grout to the lower structure walls and will not be carried by the leveling bolts.

2.4 JOINT MATERIALS

A. Mortar used for the structures herein specified shall conform to ASTM C387. Admixtures may be used not exceeding the following percentages of weight of cement: hydrated lime, 10 percent; diatomaceous earth or other inert materials, five (5) percent. The consistency of the mortar shall be such that it will readily adhere to the precast concrete if using the standard tongue and groove type joint. Mortar mixed for longer than 30 minutes shall not be used.

B. Non-Shrink Grout – See Section 03 60 00

C. Rubber gaskets shall conform to ASTM C443.

D. Preformed mastic gaskets for vault, manhole, and wet well joints shall meet Federal Specification SS-S-00210 (210-A) and AASHTO M-198B.

E. Waterproof sealant for vault pipe penetrations shall be Vulkem 921 or approved equal.

PART 3 EXECUTION

3.1 GENERAL

A. The Contractor shall design the method of placement for all precast items and shall add all reinforcing steel, embedments, bracing, and other items necessary for such

placement. All portions of embeds that remain embedded in the concrete shall be made of stainless steel.

B. The Contractor shall safely install all precast items with no damage to the precast item or any other structure, piece of equipment, or appurtenance.

C. Precast structures shall be installed in accordance with the manufacturer's recommendations, unless otherwise required by the Contract Documents.

D. Subgrade Preparation: Subgrade shall be compacted to 95 percent of the maximum dry density when soil properties are known. When soil properties are unknown, Contractor shall proof roll the subgrade to demonstrate adequate compaction for approval by the Owner. Unless otherwise identified on the Plans, place a minimum of six (6) inches of Crushed Surfacing Top Course (CSTC), as described in the WSDOT Standard Specifications. The CSTC base shall be graded and compacted to a uniform, level surface to fully support the structure and to an elevation that will assure proper positioning of the top slab or lid.

E. Joints: All joints for vaults, manholes, and wet wells shall be sealed watertight by the use of rubber gaskets or preformed sealant. All joints shall then be filled with non-shrink grout inside and out to produce smooth interior and exterior surfaces.

3.2 PRECAST CONCRETE MANHOLES AND WET WELLS

A. All rigid, non-reinforcing pipe entering or leaving the manhole (new or existing manhole) or wet well shall be provided with flexible joints within one foot of the structure and shall be placed on compacted bedding. Concrete pipe and ribbed HDPE pipe connections to manholes shall be grouted watertight with non-shrink grout. PVC pipe shall be connected to manholes using an approved adapter specifically manufactured for the intended service. Adapters shall be Kor-N-Seal or approved equal.

B. Manhole and Wet Well Riser Sections and Top Slabs

1. Precast manhole components may be used to construct standard, drop, and flow-through manholes. Manholes less than four (4) feet in depth measured from the spring line of the pipe to the bottom of the lower riser ring shall be flat top manholes.

2. Install manhole riser sections at the location shown on the plans. All sanitary sewer and pollution control manhole joints shall be watertight and shall use rubber gaskets or a preformed sealant. All joints shall then be filled with non-shrink grout inside and out so as to produce smooth interior and exterior surfaces. All manhole penetrations shall be watertight. Complete manholes shall be rigid.

3. All lift holes shall be thoroughly wetted, completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness.

4. The shortest length of riser section to be incorporated into the manhole shall be installed immediately below the flat slab top or cone.

5. Properly locate and plumb each manhole riser section.

6. Install manhole extensions and top slabs in accordance with manufacturer's specifications and as shown on the Plans. Lay section risers with the side plumb and the tops level. Make joints and penetrations watertight.

C. Grates, Frames, and Covers

1. Manhole frames, grates, and covers shall be installed in such a manner as to prevent infiltration of surface or groundwater between the frame and the concrete of the manhole section. Use preformed rubber ring to form a watertight seal.

2. Manhole frames and covers shall be installed to grades shown on the Plans or as directed by Owner.

3. Adjustment of manhole castings shall be made using specified precast grade rings and approved rubber ring joints.

4. The maximum depth of adjustment below any manhole casting shall be 16 inches, and a minimum depth of adjustment shall be four (4) inches.

D. Manhole and Wet Well Hydrostatic Test

1. The hydrostatic testing of manholes and wet wells shall consist of plugging all inlets and outlets and filling the manhole or wet well with water. The manhole or wet well shall be filled to the rim at the start of the test. Leakage in the manhole or wet well shall not exceed 0.2 gallons per foot of head above the invert after a one-hour test period. Leakage shall be determined by refilling to the rim using a calibrated known volume container. The manhole or wet well may be filled 24 hours prior to the time of testing to permit normal absorption into the walls.

END OF SECTION

SECTION 40 05 00

COMMON REQUIREMENTS FOR PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. This Section applies to the furnishing and installation of piping inside a building, structure, enclosure piping and miscellaneous yard piping. All work shall conform to the Standard Specifications except as modified herein. In the case of discrepancy, the more stringent provision shall apply.

1.2 REQUIREMENTS

A. The Contractor shall furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.

1.4 COORDINATION

A. Coordinate installation of specified items with installation of valves and equipment.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit manufacturer catalog information for each product specified.

C. Shop Drawings:

1. Identification:

a. Submit list of wording, symbols, letter size, and color coding for pipe identification.

b. Comply with ASME A13.1.

2. Provide all necessary dimensions and details on pipe joints, restraints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists.

3. Provide detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, couplings, and pipe supports necessary to accommodate the equipment and valves provided in a complete and functional system.

D. Manufacturer's Statement: Certifying pipe fabrication and products meet or exceed specified requirements.

E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS and ASME qualification within previous 12 months.

F. Manufacturer Instructions: Submit special procedures and setting dimensions.

G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.

H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping appurtenances.

B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

A. Drawings:

1. Piping layouts shown in the Drawings are intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.

B. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. Welds shall be tested as specified. The Contractor shall perform all tests at no additional cost to the Owner.

1.8 MATERIAL DELIVERY, STORAGE AND INSPECTION

A. See Section 01 66 00

1.9 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

A. Unless specified otherwise or indicated differently in the Drawings, all piping systems and process piping materials shall be as listed in the table below or as shown on the Drawings:

Service	Installation	Material
Wall Drain	Adjacent to wall	HDPE Smoothwall, perforated
Wall Drain	Not adjacent to wall	HDPE Smoothwall, non-perforated
Sewer Pressure Pipe	all	Class 53 Ductile Iron, linings and coatings as noted below
Sewer Gravity Pipe	all	PVC 3034
	Miscellaneous Pipelines	As shown in the Drawings

2.2 DUCTILE IRON PIPE AND FITTINGS

A. All ductile iron pipe shall conform to the current provisions of the American Water Works Association (AWWA)/American National Standards Institute (ANSI) C151/A21.51. Unless otherwise designated, ductile iron pipe shall be standard thickness Class Number 52 with cement mortar lining. Flanged ductile iron pipe shall be standard thickness Class Number 53 with cement mortar lining.

B. Pipe and fittings shall be flanged, mechanical joints or push-on as required, as shown on the drawings or as specified. Unless otherwise shown on the drawings or specified herein, mechanical joint pipe shall be used for underground installations. Joints of the push-on type may be used instead of mechanical joints after the Engineer has approved design. Restrained joints shall be the lock-type mechanical joint or approved equal at bends and for sufficient distance on each side of the bend to prevent pulling at the joint during testing. No set screw type retainer glands or joint harness systems will be allowed.

C. Restrained joints shall be “Megalug” by EBAA Iron, Inc. No or equals.

D. Threaded flanges shall meet the requirement of AWWA Standard C115 and shall be installed only on pipe with a minimum Class 53 wall thickness.

E. Flanged pipe shall be flanged in accordance with AWWA/ANSI C115/A21.15 with Class 125 drilling. Flanges shall have flat faces and shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown.

F. Flanged gaskets for 150 psi rated ductile iron piping systems shall be composed of neoprene, Buna N, chlorinated butyl, or cloth inserted rubber; full faced and 1/8-inch thick conforming to ANSI/AWWA C111/A21.1.

G. Fittings for ductile iron pipe shall conform to AWWA/ANSI C110/A21.10 or AWWA/ANSI C153/A21.53. Rubber gaskets shall conform to AWWA/ANSI C111/A21.11. Fittings shall be mechanical joint or flanged.

2.3 HDPE DRAINAGE PIPE AND FITTINGS

A. All pipe sizes shown on the Plans and specified in this Section reference nominal diameter, unless otherwise indicated. Pipe sizing shall be in accordance with ASTM F810, Standard stiffness, with smooth interior and exterior.

B. Perforated pipe perforations shall be cleanly cut so as not to restrict the inflow of water, and uniformly spaced along the length and circumference of the tubing. Circular perforations shall not exceed 3/16-inch diameter. Slots shall not exceed 1/8-inch in width nor 10 percent of the nominal inside circumference. The water inlet area shall be minimum of 1 square inch per linear foot of tubing.

C. HDPE Fittings shall be manufactured from the same class of materials and fully compatible with the HDPE pipe.

2.4 RESTRAINED FLANGE ADAPTERS FOR DUCTILE IRON PIPE

A. Description:

1. ASTM A536, ductile iron.

2. Flange bolt circles compatible with ANSI/AWWA C115/A21.15.

3. Restraint for the flange adapter shall consist of a plurality of individually actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of the gripping wedges.

4. Capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.

5. Safety factor of 2:1 minimum.

6. Manufacturer:

    a. EBAA Iron, Series 2100 Megaflange or approved equal.

2.5 PIPE COATINGS

A. See Section 09 90 00, Painting and Coatings.

PART 3 EXECUTION

3.1 GENERAL

A. Furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill and encasement, to provide a functional installation.

B. Pipe shall be installed in accordance with good trade practice. The methods employed in handling and placing of pipe, fittings, and equipment shall be such as to ensure that after installation and testing they are in good condition. Should damage occur to the pipe, fitting or equipment, repairs satisfactory to the Engineer shall be made.

3.2 INSTALLATION

A. Interior Piping Systems:

1. Install non-conducting dielectric connections wherever joining dissimilar metals.

2. Establish elevations of buried piping outside valve vault to obtain not less than 3 feet of cover.

3. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting as specified in Section 09 90 00, Painting and Coating.

4. Install water piping according to ASME B31.9.

5. Install unions downstream of valves and at equipment or apparatus connections.

6. Install brass male adapters each side of valves in copper piped system; solder adapters to pipe.

3.3 TESTING

A. See Section 01 46 00.

END OF SECTION

SECTION 40 05 51

COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes basic materials and methods related to valves commonly used for process systems, including pump stations and utility vaults.

B. The provisions of this Section shall apply to all valves and valve operators specified in the various Sections of Division 40 of these Specifications except where otherwise specified in the Contract Documents. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls specified in other Sections of these Specifications.

C. Section Includes:

1. Valves
2. Valve actuators

1.2 COORDINATION

A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Product Data:

1. Submit manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

2. Submit valve cavitation limits.

3. Submit manufacturer data for actuator with model number and size indicated.

C. Shop Drawings:

1. Submit description of proposed installation, including associated wiring diagrams and electrical data as may be specified elsewhere in the contract documents.

2. Provide assembly drawings indicating parts list, materials, sizes, position indicators, limit switches, actuator mounting, wiring diagrams, and control system schematics.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.

F. Lining and coating data.

G. Valve Labeling Schedule: Indicate valve locations and nametag text.

H. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.

I. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and actuators.
B. Operation and Maintenance Data: Submit information for valves and actuators.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of manufacturer's recommended spare parts.

B. Tools:

1. Furnish special wrenches and other devices required for Owner to maintain equipment.

2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.6 QUALITY ASSURANCE

A. Cast manufacturer's name, pressure rating, size of valve and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure or the minimum hydrostatic test pressure for the piping system, whichever is greater.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Maintain clearances as indicated on Drawings and Shop Drawings.

E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first class quality and shall be made by reputable manufacturers.

F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions.

1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.

3. Provide additional protection according to manufacturer instructions.

D. Handle products carefully to prevent damage to interior or exterior surfaces.

E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

1.8 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.

1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.

2. All brass in contact with potable water shall comply with ASTM B584.

2.2 VALVES

A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required and shown in the Drawings.

B. Operation:

1. Open by turning counterclockwise; close by turning clockwise.

2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.

C. Valve Construction:

1. Bodies: Rated for maximum temperature and pressure to which the valve will be subjected as specified in valve Sections and as required for system hydrostatic pressure testing for this project.

D. Connecting Nuts and Bolts: Stainless steel.

E. Valve Flanges -- The flanges of valves shall be in accordance ANSI B16.1, ANSI B16.5 and ANSI/AWWA C115/A21.15 as required. Contractor shall coordinate with pipe, valve and fitting suppliers to make certain that pipe, valve and fitting flanges match in bolt pattern.

F. Valve Boxes -- Valve box shall be of cast iron, two-piece slip type standard design with a base corresponding to the size of the valve. The box shall be coal tar painted by the manufacturer using its standard. The cover shall have the word “WATER” cast in it.

G. Protective Coating -- The valve manufacturer shall certify in writing that the required coating has been applied and tested in the manufacturing plant prior to shipment, in

accordance with these Specifications. Flange faces of valves shall not receive protective coatings.

H. Valve Operators -- Valve operators shall be as shown or as specified for a valve type. Provide operator extensions to 12 inches below grade where depth to valve exceeds three (3) feet. Provide floor stands where shown.

I. Valve Labeling -- If required by the drawings and/or these specifications, a label shall be provided on all exposed (not buried) shut-off valves exclusive of hose bibbs. The label shall be of 1/16-inch plastic or stainless steel, minimum two (2) inches by four (4) inches in size, and shall be permanently attached to the valve or on the wall adjacent to the valve as directed by the Engineer.

2.3 PLUG VALVES

A. As specified in Section 40 05 62, Plug Valves.

2.4 VALVE ACTUATORS

A. All valves shall be furnished with manual actuators, unless otherwise indicated in the Drawings.

B. Valves in sizes up to and including four inches in diameter shall have direct acting lever or handwheel actuators of the manufacturer's best standard design.

C. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.

D. Provide actuators with position indicators for shutoff valves 6 inches and larger.

E. Comply with AWWA C541 and C542, where applicable.

F. Furnish gear operators for quarter turn valves 8 inches and larger, and chainwheel operators for valves mounted over 5'-6" feet above floor.

G. Provide gear and power actuators with position indicators.

H. Gear-Assisted Manual Actuators:

1. Provide totally enclosed gears.

2. Maximum Operating Force: 60 lbf.

3. Bearings: Permanently lubricated bronze.

4. Packing: Accessible for adjustment without requiring removal of actuator from valve.

I. Handwheel:

1. Furnish permanently attached handwheel for emergency manual operation.

2. Rotation: None during powered operation.

3. Permanently affix directional arrow and cast OPEN or CLOSE on handwheel to indicate appropriate direction to turn handwheel.

4. Maximum Operating Force: 60 lbf.

J. Valve Actuators in NEC Class I, Group D, Division 1 or 2 Hazardous Locations: UL approved.

2.5 SOURCE QUALITY CONTROL

A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping system is ready for valve installation.

3.2 PREPARATION

A. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.

B. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

C. Valve Boxes: All buried valves shall be furnished with valve boxes. For valves installed out of paved or otherwise hard surfaced areas shall be set in a concrete pad at finished grade. Concrete valve box pads shall be 18 inches square and be not less than 6 inches thick. Valve boxes, except those of special design as required by the plans, shall be of cast iron of the two-piece extension type with a cast iron cover. Valve boxes shall have walls not less than 3/16-inch thick at any point, and the internal diameter shall be not less than 5 inches. Valve box covers shall have the word “WATER” cast into them as appropriate to their place of use. Valve box covers shall be of design and construction

which prevents dislodging and rotation from traffic and shall be of the type which allows a hand held pry bar to be applied for easy removal. Valve boxes shall be constructed of high quality castings and shall be the product of a manufacturer approved by the Engineer and/or Owner.

3.3 INSTALLATION

A. Install valves, actuators, extensions, and accessories according to manufacturer instructions.

B. Firmly support valves to avoid undue stresses on piping.

C. Coat studs, bolts, and nuts with anti-seizing lubricant.

D. Clean field welds of slag and splatter to provide a smooth surface.

E. Install valves with stems upright or horizontal, not inverted.

F. Stem extensions shall be braced at no greater than 10 feet intervals and be provided with double universal joints to allow for misalignment.

G. Install valves with clearance for installation of insulation and allowing access.

H. Provide access where valves and fittings are not accessible.

I. Comply with Division 40 for piping materials applying to various system types.

J. Valve Applications:

1. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.

2. Install shutoff and isolation valves.

3. Isolate equipment, part of systems, or vertical risers as indicated on Drawings.

4. Install valves for throttling, bypass, or manual flow control services as indicated on Drawings.

K. Disinfection of Water Piping System:

1. Flush and disinfect system in accordance with City Standards.

3.4 FIELD QUALITY CONTROL

A. Valve Field Testing:

1. Test for proper alignment.

2. If specified by valve Section, field test equipment to demonstrate operation without undue leakage, noise, vibration, or overheating.

3. Engineer will witness field testing.

END OF SECTION

SECTION 40 05 62

PLUG VALVES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes information related to plug valves. Contractor shall furnish and install plug valves, complete and operable, as shown and specified herein, including coatings and linings, appurtenances, operators, and accessories, in accordance with the requirements of the Contract Documents.

1.2 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

PART 2 PRODUCTS

2.1 GENERAL

Plug valves shall be furnished and installed as shown and as specified herein.

2.2 MATERIALS AND MANUFACTURERS

A. Plug Valves Two (2) Inches to Twenty (20) Inches

1. General – Unless otherwise shown on the Contract Drawings, plug valves shall be the non-lubricated eccentric type valve providing dead tight shut-off. Valves shall be bubble tight at the full rated pressure in either direction. Valves shall be suitable for throttling service and operation after long periods of inactivity.

2. Body – All bodies shall be constructed of cast iron ASTM A-126, Class B. Flanges shall fully conform to the drilling and thickness requirements of ANSI B16.1, Class 125. Body wall thickness shall conform to AWWA C504-80.

3. Plug – Single solid piece, ductile Iron ASTM A-536 and in compliance with AWWA C-604.

4. Port Area – Passage size shall be full port on all sizes for minimum pressure drop. Valve must be capable of passing the same solids requirements as the pump specifications.

5. Body Seat – Seating surfaces shall meet the requirements of AWWA C509-80.

6. Bearings – Stainless steel thrust bearings on the upper and lower bearing journals.

7. Shaft Seal – Cartridge type with two (2) O-rings, or V-cup type, self-adjusting, wear compensating. Packing shall be replaceable without removing the valve bonnet or plug.

8. Rating – Valves shall be rated for 150 psi.

9. Coating – Interior and exterior epoxy coated – 8 mill minimum per AWWA 550-81.

10. Actuator – Actuator mechanism must be fully isolated from line media. Valve geared actuators shall be mounted and tested at valve manufacturer's factory. Handwheels shall be provided except when buried or indicated otherwise on the contract drawings.

11. Valves and actuators shall have seals on all shafts and gaskets on covers to prevent leakage of liquid out and the entry of dirt or liquid into the valve. Valves to be buried shall be rated by the manufacturer for buried service.

B. Manufacturer: Dezurik, model PEF, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

A. Valve seats and actuators shall be located and oriented as shown on the Plans. When not shown on the Plans, Contractor shall coordinate positions and orientations of seats and actuators prior to installation. In general, the seat side of the valve shall be toward whatever is intended to be isolated from line pressure.

END OF SECTION

SECTION 40 61 13

PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 GENERAL

1.1 SUMMARY

A. This section specifies general requirements which are applicable to providing instrumentation and controls for the process system

B. The requirements of this section are applicable to all work to be completed by the System Integrator and as specified in all sections of Division 40.

C. Electrical requirements applicable to this work are specified in Division 26.

D. Section includes:

1. Scope
2. Definitions
3. Quality Assurance.
4. Systems Responsibility
5. Submittals.
6. Products.
7. Installation.
8. Testing.
9. Manufacturers Services.

1.2 SCOPE

A. The City has pre-selected a Systems Integrator familiar with the City's SCADA and instrumentations standards. The pre-selected integrator's work consists of the requirements in this specification section listed herein.

1. New primary process measurement devices, instrumentation and new process auxiliary devices.

2. New SCADA system hardware including digital process controllers (PLC based), IO modules, power modules, communication modules, network switches, and UPS.

3. New custom control panels, including circuit breakers, motor starters and Automatic transfer switch along with SCADA hardware.

4. Process control system networking.

5. Submittal documentation for process systems instrumentation and control including schedules, drawings, product manuals.

6. Maintaining construction RECORD/AS BUILT of submittal documentation and incorporating interconnection detail from other sections submittals to show accurately process systems instrumentation and control wiring as complete from circuits start and end connections.

7. Configuration set up, calibration, testing process systems instrumentation and controls.

8. Programming of the PLC, OIT and Cellular communications equipment.

9. Training.

10. Factory test process control panel customized fabrication(s).

B. The lift station pumping instrumentation system is based on previous systems provided to the City and includes the following general requirements.

1. Wetwell Level monitoring and control with float switch backup. Level controls shall use a submersible pressure transducer to start and stop the pumps utilizing a PLC and motor controllers communicating over Profinet. When the level system is in "Auto" the pumps shall operate in a LEAD/LAD/ALTERNATE mode and shall maintain a level between the "Lead Pump On" level and "All Pumps Off" level. If the system cannot maintain this level with the lead pump, the secondary pump shall be called at the "Lag Pump On" level. In "Hand" mode, a pump should start and operate until returned to the "Auto" or "Off" mode. When a system pump is in the "Off" mode, the associated pump shall not run. Float backup control shall be via hardwired control using standard control relay wiring and shall call both pumps in the event of PLC or level transducer failure and the High-High level float is reached. Under float backup control, the pumps shall pump down from the High-High level float with an off-delay timer set to stop the pumps slightly above the pump suction level. The first pump shall start immediately with the second pump starting after a short time delay to "step" the second pump on.

2. Generator and Automatic Transfer Switch (ATS) status. Signals from the generator and ATS, as shown on the contract drawings, shall be wired to a PLC for remote monitoring.

3. Intrusion and "Operator in trouble" switches shall be installed in the Master Control Panel (MCP) for remote monitoring.

4. An Operator Interface Terminal (OIT) shall be provided for adjustment of all PLC controlled system setpoints and settings. The OIT shall indicate system status of

the various control instruments and pumps in the system. It shall be setup for logging and monitoring Level signal as well as providing alarm monitoring.

C. Additional elements for the System include the programming and updating of the City's SCADA system at the City's shops.

1.3 DEFINITIONS

A. GENERAL: Definitions of terminology related to Instrumentation and Industrial Electronic Systems used in the specifications as defined in IEEE 100, ISA S51.1, and NEMA ICS 1.

B. VENDOR PACKAGE PROCESS CONTROL SYSTEM: A system of equipment and hardware provided by a vendor used for control, monitoring process conditions, control feedback and process performance for an associated vendor package equipment system which interfaces to the control system.

C. TWO-WIRE TRANSMITTER: An instrument which derives operating power supply from the signal transmission circuit and requires no separate power supply connections. A two-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit from a 24-volt direct current driving potential and a maximum circuit resistance of 600 ohms. A two-wire transmitter is also referred to as looped power.

D. FOUR-WIRE TRANSMITTER: An instrument which derives operating power from separate power supply connections. A four-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit with a maximum circuit resistance of 600 ohms. Four-wire transmitters typically require 120Vac or 24Vdc input power supply.

E. GALVANIC ISOLATION: Electrical node having no direct current path to another electrical node. Galvanic isolation refers to a device with electrical inputs and/or outputs which are isolated from ground, the device case, the process fluid, and separate power supply terminals. Inputs and/or outputs may be externally grounded without affecting the characteristics of the devices or providing path for circulation of ground currents.

F. PANEL: An instrument support system which may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems including consoles, cabinets and racks. Panels provide mechanical protection, electrical isolation, and protection from dust, dirt, moisture, and chemical contaminants which may be pre- sent in the atmosphere.

G. DATA SHEETS: Data sheets shall refer to ISA S20 or ISA TR20.00.01 latest version.

H. SIGNAL TYPES:

1. LOW-LEVEL ANALOG: Signal with full output level of 100 millivolts or less including thermocouples and resistance temperature detectors.

2. HIGH-LEVEL ANALOG: Signals with full output level greater than 100 millivolts but less than 30 volts, including 4 to 20 mA transmission.

3. PULSE FREQUENCY: Counting pulses emitted from speed or flow transmitters.

4. DISCRETE CONTROL OR EVENTS: Dry contact closures and signals monitored by solid state equipment, relays, or control circuits typically rated for 120 volts AC or 24 volts DC.

I. SYSTEMS INTEGRATOR: The Owner's pre-selected firm providing the control system design and engineering, custom panel fabrication, instrumentation component purchase, instrumentation tuning, testing and programming of the specified process control and industrial automation systems.

1. S&B, Inc.
   a. Contact: Eric Dinh
   b. Phone: (425) 644-1700

J. OIT: Acronym for Operator Interface Terminal

K. SCADA: Acronym for Supervisory Control And Data Acquisition

L. PLC: Acronym for Programmable Logic Controller – synonymous with Programmable Automation Controller (PAC) for purposes of this project

1.4 QUALITY ASSURANCE

A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or other- wise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
ISA S5.4	Instrument Loop Diagrams
ISA S20	Specification Forms For Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology
ISA TR20.00.01	Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
NEMA ICS 1	General Standards for Industrial Control and Systems
NEMA ICS 2	Standards for Industrial Control Devices, Controllers and Assemblies
NEMA ICS 3	Industrial Systems
NEMA ICS 4	Terminal Blocks for Industrial Control Equipment and Systems
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NETA	National Electrical Testing Association
UL 508	Industrial Control Equipment
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous Locations
UL 913	Intrinsically Safe Apparatus for us in Hazardous Locations

C. Electrical testing laboratory conformance.

1. All panel provided under this section shall be labeled by a Nationally Recognized Testing Laboratory (NRTL) of electrical systems, acceptable to the State of Washington. Underwriters' Laboratory (UL) and Electrical Testing Labs (ETL) are such NRTLs. Labels shall be provided by an entity that is currently registered and authorized by the NRTL to provide such a label.

2. All panels provided under this section shall be acceptable to the State of Washington and the Authority Having Jurisdiction (AHJ).

3. Contractor shall provide additional design, components and equipment necessary to meet the requirements of the applicable NRTL standard.

1.5 SYSTEMS RESPONSIBILITY

A. GENERAL

1. The Contractor shall be ultimately responsible and shall provide for all labor, equipment, and materials not provided by others that are necessary for the supply,

installation, certification, adjustment, testing, and start-up of a complete coordinated System that shall reliably perform the specified functions of the specifications and contract drawings.

2. The Contractor shall be responsible for coordinating with the City's designated Systems Integrator to ensure proper operation of the System, including all status and control signals between the SCADA system and the local PLC/OIT. Contractor shall participate in all System testing, making adjustments as required, and the Contractor's work shall not be considered "complete" until fully accepted by the City and their designated Systems Integrator.

3. The Contractor shall coordinate their work to ensure that:

   a. All components provided under this section, whether Contractor provided or provided by others for Contractor to install are properly installed and operational.

   b. The proper type, size and number of control conductors and their conduits are provided and installed.

   c. Proper electric power circuits are provided for all components and systems and their conduits are provided and installed.

4. The Contractor shall participate in the testing and adjustment of all field devices at start-up.

5. The City's designated Systems Integrator shall be responsible for the items under Part 1.2 Scope listed above and as described in Attachment "C".

6. The specified system performance shall be demonstrated to and accepted by the Owner.

1.6 SUBMITTALS

A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

    a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

    b. Failure to include a list of the specification section deviations 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

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

    a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.

    b. Catalog cuts shall be edited to show only the items, model numbers, and information which are applicable and crossing out all inapplicable information.

    c. Submittals are to made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable. Submittals that are not submitted in the format outlined may be rejected outright and the Contractor is required to resubmit in the correct format.

4. Manufacturer's installation instruction excerpts that apply to this project:

    a. Mounting requirements
    b. Electrical connection diagrams
    c. Calibration procedures
    d. Operation and maintenance information
    e. Warranty information

5. Provide Seismic calculations for anchoring and support of equipment as required in Section 01 41 20.

C. SUBMITTAL DRAWINGS

1. GENERAL

a. Prepare drawings in AutoCAD version 2020 or later with borders and titleblocks identifying the project and system.

b. Diagrams shall carry a uniform and coordinated set of wire numbers and terminal block numbers

c. The drawing numbers and file names are to be based on equipment tag numbers

d. Provide the following submittal drawings

    1) Arrangement and layout drawings

        a) Contract document's drawings are typical illustrations of panel hardware/component arrangement and layouts representing one or more than one panel with similar interconnection requirements. Provide the unique panel arrangement, layout and outline drawings. Show arrangement and layout to scale. Add components and wiring to the unique panel drawings as required to complete a fully integrated operation. Include on the drawings a Bill of Material that identifies all components in the arrangement and layout.

    2) Schematic diagrams

        a) Show components of a control panel in an arrangement similar to the actual layout of the panel including internal wiring between devices include IO module layout connections. Show terminal blocks used for internal wiring or field wiring, identified as such

    3) Loop diagrams

        a) Provide the unique loop diagram for each piece of equipment.

    4) Network block diagram

        a) A network block diagram is a diagram of the control system, with annotated boxes to show the primary network components (controllers, hubs, switches, computers, displays), and annotated interconnecting lines that show the system communication media and communication protocols].

PART 2 PRODUCTS

2.1 GENERAL

A. Provide process control hardware new, free from defects, and industrial-grade, as specified. Each type of instrument, instrument accessory, and device used throughout the work shall be manufactured by one firm, where possible.

B. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturer's regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.

C. Provide material and equipment that is acceptable to AHJ as suitable for the use indicated. For example, provide wet location rated equipment for locations that are wet.

D. The design of the Instrumentation and Controls system shown in the contract drawings is based on previous system designs provided by the City's System Integrator and therefore all products provided shall be similar to such previous designs and meet all NRTL requirements for the system to be provided.

2.2 WARRANTY

A. All electronic equipment shall be warrantied for a minimum of one year for parts and labor from installation and system turn-over date.

PART 3 EXECUTION

3.1 PANELS AND PANEL MOUNTED EQUIPMENT

A. Panels and panel-mounted equipment shall be pre-assembled at the control supplier's factory. No work, other than correction of minor defects or minor transit damage, shall be done to the panels at the job site.

B. Panels shall be mounted where shown. Contractor shall anchor the panels as shown. Provide shims as required to set panels level. Conflicts with other equipment shall be brought to the attention of the Engineer for direction before taking any further action.

3.2 INSTALLATION

A. Protection During Construction: Throughout this Contract, the Contractor shall provide protection for materials and equipment against loss or damage and from the effects of the weather. Prior to installation, store items in indoor, dry locations. Provide heating in storage areas for items subject to corrosion under damp conditions.

B. Material and Equipment Installation: Follow manufacturer's installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturer's instructions, and these Contract Documents, follow Engineer's decision, at no additional cost to Owner. Keep copy of manufacturer's instructions on the job site available for review at all times.

C. The Contractor shall bear ultimate responsibility and shall provide for the supply, installation, adjustment, and startup of a complete, coordinated System that shall reliably perform the specified functions.

D. The Contractor shall make all final power and signal connections (hydraulic, pneumatic, and electric) to all elements provided under this section. The Contractor shall verify and certify by written notice to the Engineer, the correctness of final signal connections and the correctness of adjustment for all elements provided under this section and all elements interfaced with the System.

E. All conduits are provided and installed under Section 26 05 33-Raceways, Boxes & Fittings.

F. All wiring and cables, with the exception of certain specified special control cables, are provided and installed under Section 26 05 19-Low Voltage Conductors, Wires and Cables. Special control cables for control and communication with the Master Control Panel shall be provided and installed under Attachment “C”.

G. Cleaning and Touch-up Painting: Keep premises free from accumulation of waste material or rubbish. Upon completion of work, remove materials, scraps, and debris from premises and from interior and exterior of all devices and equipment. Touch-up scratches, scrapes, and chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the color, consistency, and type of surface of the original finish.

3.3 ELECTRICAL POWER AND SIGNAL WIRING

A. Control and signal wiring external to the panels and all power wiring shall conform to the requirements of Section 26 05 19-Low Voltage Conductors, Wires and Cables.

B. Arrange wiring neatly, cut to proper length, and remove surplus wire.

C. Use manufacturer's recommended tool with the proper sized anvil for all crimp terminations. No more than two wires may be terminated in a single crimp lug and no more than two lugs may be installed on a single screw terminal.

1. All crimp lugs used in applications with two wires terminated in a single crimp lug shall be rated by the manufacturer for multiple wire use.

D. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.

3.4 TESTING, START-UP AND TRAINING

A. All elements of the System shall be tested to demonstrate that the System satisfies all of the requirements of this Specification.

B. The Contractor shall provide all special testing materials and equipment.

C. The Contractor shall coordinate all of his testing with the Engineer, equipment manufacturer's representatives and all associated sub-contractors.

D. As a minimum, the testing shall include the following:

1. Factory tests: Prior to shipment, all panel assemblies shall be tested for proper operation at the manufacturer's factory. Results of the factory tests shall be recorded and submitted for approval before shipment of any panel assembly to the project site.

2. Operational Acceptance Tests

   a. The objective of these tests are to demonstrate that the System is READY for final operation.

   b. The Contractor shall complete the pre-startup checklist provided by

   c. The System shall be checked for proper installation, adjustment, and calibration on an "element-by-element" basis to verify that it functions as specified and that all terminations have been made correctly.

   d. All discrete element set points shall be adjusted and checked for proper operation (e.g., interlock function, contact closure on rising/falling P.V., etc.).

   e. All analog loops shall minimum, 4-20mA analog signals shall be tested at 4, 8, 12, 16, and 20.

   f. The "Operational Acceptance Tests" shall be completed prior to starting the "Functional Acceptance Test". The actual testing program shall be conducted in accordance with prior approved procedures and shall be documented.

3. Functional Acceptance Tests

   a. The objective of these tests are to demonstrate that the System operates correctly and complies with the specified performance requirements. All data points shall be tested by activating the field elements and verifying proper System response. The Contractor shall provide a minimum of (2) day Functional Acceptance Test for each control panel by qualified personnel. One day of testing shall constitute eight (8) hours of on-site work. During this period, the

Contractor's personnel shall operate the System under normal and all alarm conditions to simulate all operating modes of all equipment.

b. A witnessed "Functional Acceptance Test" shall be performed on the System. Each function shall be demonstrated to the satisfaction of the Owner or Owner's representative.

c. Each instrument and final element shall be field calibrated in accordance with the manufacturer's recommended procedure and then tested in accordance with the Contractor's approved test procedure. Data shall be entered on the applicable test form at the time of testing. Alarm trips, control trips, and switches shall be set to initial values. Final elements shall be checked for range, dead-band, and speed of response. Any component that fails to meet the required tolerances shall be repaired by the manufacturer or replaced, and the above tests repeated until the component is within tolerance.

d. Adjust tuning constants as required for proper System operation. Provide final tuning constant information for inclusion in the Operation and Maintenance Manuals.

e. The actual testing program shall be conducted in accordance with the prior approved procedures and shall be documented as required.

f. The Contractor shall notify the Engineer, and submit the specified test reports of the "Operational Acceptance Tests," at least 1 week prior to the date of the "Functional Acceptance Test".

g. Provide minimum Owner training as part of the Functional Acceptance testing. Training shall include panel safety, indicator pushbutton, pilot device, and OIT operation, troubleshooting, and spare parts inventory.

END OF SECTION

SECTION 43 21 00

LIQUID PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated.

B. Where two or more pump systems of the same type or size are required, all pumps shall be produced by the same manufacturer.

C. Provide all labor, equipment, and materials, and perform all operations in connection with the installation and testing of pumps selected by the Owner.

D. Coordinate and utilize all factory testing, installation, start-up and field testing services supplied in conjunction with the pumping equipment.

E. All work performed under this Section shall be in accordance with all approved trade practices and manufacturer's recommendations.

F. Section includes:

1. General design requirements for liquid pumps

2. Factory testing

1.2 SUBMITTALS

A. Shop Drawings: Provide the following information:

1. Pump name, identification number, and applicable Section number from Project specifications.

2. Performance Data Curves:

a. Showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump.

b. Pump manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions.

c. A family of performance curves at intervals of 100 rpm from minimum speed to maximum speed shall be provided for each centrifugal pump equipped with a variable speed drive, and a curve for each speed on two-speed pumps.

3. The limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration.

4. Assembly and Installation Drawings: Including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

B. Complete motor nameplate data as defined by NEMA, motor manufacturer and any motor modifications.

C. Operation and Maintenance Manual: Containing the required information for each pump section.

D. Spare Parts List: Containing the required information for each pump section.

E. Factory Test Data: Signed, dated and certified for each pump system which requires factory testing submitted before shipment of equipment.

F. Certifications:

1. Manufacturer's certification of proper installation.

2. Contractor's certification of satisfactory field testing.

3. Certificate of Compliance for Seismic Design of Nonstructural Components and Systems

G. All pump motor information as required in Division 43.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials and equipment shall be standard products of a manufacturer and distributor regularly engaged in the manufacture and distribution of such products for at least 2 (two) years and shall be suitable for the service intended.

B. All materials and equipment shall be new and unused except for the testing specified herein.

C. Compliance with the requirements of the individual pump sections may necessitate modifications to the manufacturer's standard equipment.

D. All centrifugal pumps shall have a continuously rising performance curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine or encroach on the service factor.

E. All components of each pump system provided under the pump sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings and appurtenances.

F. The pumps shall be supplied by a distributor authorized to service them throughout the warranty period and beyond. The distributor shall be located within a 100-mile radius of the site.

G. The pumps shall be warranted by the manufacturer for a minimum of two (2) years from the date of accepted installation.

H. All materials and coatings coming in contact with potable water shall be ANSI/NSF Standard 61 approved.

I. The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, suction cans, baseplates, couplings, guards and other accessories.

J. The complete pump assembly shall be designed and built for continuous service at any and all points within the specified range of operation, without overheating, without damaging cavitation, and without excessive vibration or noise.

2.2 MATERIALS

A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:

1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Casings, Class 30, or equal.

2. Stainless steel pump shafts shall be Type 416 or 316.

3. Miscellaneous stainless steel shall be of Type 316, except in a septic environment.

4. Anchor bolts, washers, and nuts supplied by the Contractor shall be in accordance with the requirements of Section 05 50 00, Metal Fabrications.

2.3 PUMP COMPONENTS, GENERAL

A. Flanges: Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 12, 125, 250, and 800 or B16.5 - Flanges and Flanged Fittings dimensions.

B. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the liquid passage.

2.4 PUMP APPURTENANCES

A. Nameplates: Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed and manufacturer's name and model number.

B. Gauges: Provide and install pressure gauges as shown on the Drawings.

1. All pumps (except sample pumps, sump pumps, hot water circulating pumps and chemical metering pumps) shall be equipped with pressure gauges on the pump discharge.

2. Pump suction lines shall be provided with compound gauges.

3. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.

4. Isolation diaphragms shall be provided for all gauges except where pumping potable water.

5. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.

2.5 FACTORY TESTING

A. The following tests shall be conducted on each indicated pump system:

1. Pump Systems: All centrifugal and vertical turbine pump systems 100 hp and larger shall be tested at the pump factory in accordance with the American National Standard for Centrifugal Pump Tests (ANSI/HI 1.6) or the American National Standard for Vertical Pump Tests (ANSI/HI 2.6) as approved by ANSI and published by the Hydraulic Institute.

a. Tests shall be performed using the complete pump system to be furnished, including the motor.

2. For motors 100 hp and smaller, the manufacturer's certified test motor shall be acceptable.

3. The following minimum test data shall be submitted:

    a. Hydrostatic test data.

    b. A minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.

    c. Pump curves showing head, flow, bhp, efficiency and NPSH requirements.

    d. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.

    e. Pump test data curves showing head, flowrate, bhp, and efficiency. Acceptance level shall be Grade 1E as defined by ANSI/HI 14.6.

    f. Factory vibration testing results meeting ANSI/HI 9.6.4.

    g. Mechanical test data per ANSI/HI 2.6.7, including testing for vibration, lack of leakage at shaft seals, gaskets, and other lubricated areas; and satisfactory operation of rotating parts at the rated pump operating conditions.

4. Factory Witnessed Tests: Factory witnessed testing for this project not required.

5. Acceptance: In the event of failure of any pump to meet any of the requirements, the Contractor and Pump Manufacturer shall make all necessary modifications, repairs or replacements to conform to the requirements of the Contract Documents and the pump shall be retested at no additional cost to the Owner until found satisfactory.

B. The pump manufacturer with system responsibility shall perform a complete lateral and torsional analysis of each distinct pump-motor system to be provided on this Project. This analysis shall identify the dry and wet lateral critical and the torsional critical speeds. Appropriate lateral and torsional critical speed maps shall be produced, and no active critical speed shall be allowed within 20 percent of the operating speed range. This analysis shall be performed prior to fabrication of the machinery, and a submittal shall be provided for review by the Owner's Representative in accordance with Section 01 33 00. The pump and motor manufacturers shall furnish detailed mass elastic data to the Owner's Representative, to be used for an independent evaluation of the lateral and torsional natural frequency analysis. Encroachment by plus and minus 20 percent of any active critical speeds upon the operating speed range shall be eliminated to the satisfaction of the Owner's Representative. The analysis shall be

performed by a specialist experienced in this type of work and approved by the Owner. The analysis shall be provided as part of the pump submittal

C. The specialist or their assigned representative who shall similarly be experienced in this type of work and who shall be approved by the Owner shall visit the project site during startup and testing of the equipment to analyze and measure the amount of pump vibration, certify that the operating frequency avoids the natural frequency by 20 percent, and make a written recommendation for keeping the vibration at a safe limit.

PART 3 EXECUTION

3.1 SERVICES OF PUMP MANUFACTURER

A. An authorized service representative of the manufacturer shall visit the Site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted and readied for operation:

1. Installation of the equipment.

2. Inspection, checking and adjusting the equipment.

3. Startup and field testing for proper operation.

4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements.

5. Requirements are more specifically detailed herein and in individual pump specifications.

B. Instruction of the Owner's Personnel:

1. An authorized training representative of the manufacturer shall visit the Site to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment.

2. Instruction shall be specific to the models of equipment provided.

3. The pump manufacturer's representative shall have at least two years' experience in training.

4. Training shall be scheduled a minimum of three weeks in advance of the first session.

5. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.

6. The 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. General: Pumping equipment shall be installed in accordance with the manufacturer's written recommendations.

B. Alignment:

1. All equipment shall be field tested to verify proper alignment, operation as specified and freedom from binding, scraping, vibration, shaft runout or other defects.

2. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing.

3. Equipment shall be secure in position and neat in appearance.

C. Lubricants: Provide the necessary oil and grease for initial operation.

3.3 FIELD TESTS

A. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation or overheating of bearings.

B. Field testing methods and allowable tolerances shall comply with current version of the Hydraulics Institute standards for the type of pumps installed.

C. The following field testing shall be conducted:

1. Startup, check and operate the pump system over its entire speed range. Where vibration analysis and measurement is required, it shall be within the amplitude limits specified and recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.

2. Obtain concurrent readings of motor voltage, amperage, pump suction head and pump discharge head for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.

3. Determine bearing temperatures by contact type thermometer. A run time of at least 20 minutes shall precede this test unless insufficient liquid volume is available.

4. Electrical and instrumentation tests shall conform to the requirements of the Section under which that equipment is specified.

5. Field vibration readings shall be conducted by an Owner-approved certified testing agency, paid for by the Contractor, with readings taken at the following positions with the average not exceeding the current Hydraulic Institutes standards for the type of pump installed.

    a. Measurements shall be taken at the locations as specified in the current Hydraulic Institute standards for the type of pump installed.

6. Provide written proof of vibration readings and provide test data.

D. Field testing will be witnessed by the Engineer. The Contractor shall provide a minimum of 5 business days advance notice of field testing.

E. In the event any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.

F. After each pumping system has satisfied the requirements, the Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.

G. Contractor shall bear all costs of field tests, including additional services of the manufacturer's representative required beyond those specified.

END OF SECTION

SECTION 43 25 13

SUBMERSIBLE WASTEWATER PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

A. Work covered in this Section includes furnishing, start-up, testing, and operation training for submersible sewage pumps as required for this project. Specified appurtenances, such as rails, brackets, discharge elbows, and control/power cables shall also be included. Like items of equipment specified herein shall be the end product of one manufacturer. Electrical controls and motor design requirements are specified in this section and the electrical section of these specifications. The Contractor shall be responsible for coordinating the pump requirements with the pump drive manufacturer and shall be responsible for the overall pump and drive performance.

1.2 SUBMITTALS

A. Submittals during construction shall be made in accordance with Section 01 33 00, Submittal Procedures, and Section 43 21 00, Liquid Pumps.

B. Submittals for Record – The pump supplier shall submit a manufacturer's installation and operation certificate and a statement that the equipment is suitable for the intended use.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

A. Pumps shall meet the requirements of Section 43 21 00, Liquid Pumps, and the latest version of the Hydraulic Institute Standards for Submersible Pumps, except where modified herein.

1.4 FACTORY TESTING

A. Pump manufacturer shall provide factory tests in accordance with Section 43 21 00, Liquid Pumps. All test results shall be certified to be acceptable per the testing standards, and shall be submitted to and approved by Engineer prior to shipment of equipment.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. Identification:

Location	44th St & 67th Ave Lift Station
Pump Label(s)	Pump 1, Pump 2
Quantity	2

B. Power and Motor Requirements:

Voltage	230
Phase	3
Frequency	60 Hz
Motor Speed	3,600 rpm
Motor Horsepower	7.2
Efficiency Class	Premium Efficiency

C. Performance Requirements, One Pump Running:

Duty Point Minimum Flow Capacity	200 gpm
Duty Point Total Dynamic Head	74 feet
Static Head	59 feet
Shut-off Head Minimum	110 feet
Duty Point Minimum Pump Efficiency	40 %
Maximum NPSH required at Duty Point	11 feet

D. Operating Conditions:

Duty	Continuous
Drive	Direct On-Line
Ambient Environment	Wet Well - Corrosive
Ambient Temperature	33° - 104° F
Fluid Service	Municipal wastewater, raw and unscreened, containing rags, grit, fats, oil, and debris.
Fluid Temperature	50° - 90° F
Fluid pH Range	6.0 to 8.0
Fluid Specific Gravity	1.0
Net Positive Suction Head Available	33 feet

E. Solids Passing – Pumps shall all be capable of passing solids and fibrous material commonly found in raw wastewater. 3-inch solids passing is desired. However, if 3-inch solids passing is not available, manufacturer may alternatively offer a minimum 1-year

no-clog guarantee that offers clear reimbursement for all costs associated with unclogging the pump, including staff time, as well as costs associated with damages resulting from a spill, if applicable.

F. Pumping System Dimensions:

Discharge Flange Rating (ANSI)	Class 125
Minimum Submersible Cable Length	As Required

G. Other Requirements

1 The head-capacity curve shall exhibit a uniformly rising characteristic from free discharge to shutoff. The pump motor shall be non-overloading throughout the entire pump curve.

2 The entire pump assembly shall be U.L. approved as Explosion Proof for operation in a Class 1, Division 1, Group D hazardous location.

2.2 PUMP CONSTRUCTION

A. General – The pump shall be heavy-duty vertical, submersible with integral drive motor, single suction, centrifugal, sewage type, suitable for a permanent-type wet well installation.

B. Pump – The pump shall be supplied with a mating cast iron discharge connection. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used. No portion of the pump shall bear directly on the sump floor. All exposed nuts or bolts shall be AISI type 316 stainless steel construction.

C. Impeller – The impeller shall be of (ASTM A-48, Class 35B gray iron or ASTM A-532 (Alloy III A) 25% chrome cast iron) dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. Thescrew-shaped leading edges of the gray iron impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge, and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

D. Volute – The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-IronTM (ASTM A-532 (Alloy III A) 25% chrome cast iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

E. Shaft – Pump and motor shaft shall be the same unit. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. If a shaft material of lower quality than stainless steel – ASTM A479 S43100-T is used, a shaft sleeve of stainless steel – ASTM A479 S43100-T shall be used to protect the shaft material. However, shaft sleeves only protect the shaft around the lower mechanical seal. No protection is provided in the oil housing and above. Therefore, the use of stainless steel sleeves will not be considered equal to stainless steel shafts.

F. Bearings – The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve at maximum speed.

G. Mechanical Seal – Each pump shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydro-dynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion and abrasion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion and abrasion resistant tungsten-carbide seal ring.

Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load.

H. Seal lubricant – Seal lubricant shall be FDA-approved, nontoxic. The motor shall be able to operate continuously while non-submerged without damage while pumping under load.

I. Cooling System – Motors shall be sufficiently cooled by the surrounding environment or pumped media without the need for a water jacket.

J. Pump Discharge Elbow – The pump discharge connection shall be the elbow type. The discharge connection shall be bolted to the structure as recommended by the manufacturer and shall serve as a lower attachment for the guide rails, and as anchorage for the pump. The anchorage system shall be designed to transmit all forces safely to the structure, and may incorporate intermediate supports as required. Calculations and supporting documentation justifying the support design may be requested, and shall be provided with the submittals. The design shall be non-sparking and shall conform to UL requirements for installation in a Class 1, Division 1, Group D hazardous location. When in place, the discharge connection shall cause a watertight seal between the pump and the discharge elbow, accomplished by a machined metal to metal contact only, using simple linear downward motion of the pump with the entire weight of the pumping unit guided to and pressing tightly against the discharge connections. Sealing of the discharge interface with a diaphragm, O-ring, or profile gasket shall not be acceptable. No portion of the pump shall bear directly on the floor of the wet well and no rotary motion of the pump shall be required for sealing.

K. Dual Rail Guide System – The pump shall be provided with a dual rail guide system to automatically and firmly connect the pump to the discharge piping when lowered into place on the discharge elbow. Once the pump has been positioned on its support fitting at the discharge elbow, the guide rail system shall not be required for pump support. The guide rail system shall allow easy removal of the pump without entering the wet well or disturbing the discharge piping. Single rail systems are not acceptable. All components of the guide system and pump anchorage shall be of stainless steel 316. Rails shall each be 2-inch diameter.

L. Lifting Device – Each pump shall be equipped with the Grip Eye lifting device, or approved equal. Lifting system components shall include stainless steel safety hooks, shackles, and sufficient length of chain to run from the pump to the top of the wet well plus an additional five (5) feet.

2.3 MOTORS

A. General – Each pump shall be provided with a vertically mounted standard efficient electric motor that conforms to the following requirements. Motors shall be designed to accept the total, unbalanced thrusts imposed by the pump. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and the pump shall be produced by the same manufacturer. The motor shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

B. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board, shall be hermetically sealed from the motor by an elastomer 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. The motor and the pump shall be produced by the same manufacturer.

C. Service Factors – The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

D. Power Cable – The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the pump terminal panel without the need of any splices. The power cable shall be of a shielded design in which an overall tinned copper shield is included and each individual phase conductor is shielded with an aluminum coated foil wrap. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

E. Cable Entry Seal – The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter and compressed by the body containing a strain relief function, separate from the function of sealing the cable. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be separated by a stator lead sealing gland or terminal board, which shall isolate the interior from

foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

2.4 PROTECTION

A. Each motor stator shall incorporate three thermal switches, one per stator phases winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm.

B. A leakage sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS shall activate an alarm only.

C. The thermal switches and leakage sensor shall be connected to a monitoring system that shall be designed to be mounted in any control panel.

2.5 SPARE PARTS – THE FOLLOWING SPARE PARTS SHALL BE PROVIDED:

A. One set of mechanical seals.

B. One set of O-rings.

C. One set of wear rings.

2.6 PUMP MANUFACTURER AND MODEL

A. Acceptable submersible sewage pump manufacturer shall be Xylem Water Solutions. Acceptable model shall be Flygt NP 3102 SH 256 with 135mm impeller and premium efficiency motor.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspect pumps and fittings before installation to verify quality of material.

3.2 INSTALLATION

A. Install and align pumps and fittings in accordance with the manufacturer's printed specifications and at the locations shown on the Plans. Use anchor bolts furnished or recommended by the manufacturer. Place the pumps using equipment templates.

B. Anchors for the unit shall be set in the concrete, and the unit shall be mounted as instructed by the manufacturer. Anchors shall be drilled and set with epoxy. Contractor shall provide Engineer 24 hour notice prior to installing base elbows, to allow for anchor bolt inspection. The manufacturer or appointed representative shall supervise and/or inspect installation prior to introduction of wastewater to ensure that the unit is properly aligned and leveled; that all electrical and piping connections are properly made; and that lubricants have been provided and installed.

3.3 INSPECTION AND START-UP

A. The Contractor shall furnish a representative of the manufacturer to perform inspection, start-up and training services. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment and shall instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. The representative shall check the installation and supervise initial start-up of the equipment, and shall perform, at a minimum, the following tests on each pump:

1. Measure and record shutoff head and power draw at shutoff head, clearly noting water level(s) relative to the pressure measurement location.

2. Measure and record actual operating head and power draw at actual operating head, clearly noting water level(s) relative to the pressure measurement location.

3. Measure and record operating head and power draw at two separate partially throttled flow rates, clearly noting water level(s) relative to the pressure measurement location.

4. Measure and record static head, clearly noting water level(s) relative to the pressure measurement location.

5. Duplicate all normal operating modes and all failure modes, including the removal and installation of pumps from the wet well using the guide rail system.

B. The Contractor shall furnish a representative of the manufacturer to perform inspection, start-up and training services for the pump control system. The manufacturer's representative shall be experienced in the operation and maintenance of the equipment and shall instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. The representative shall check the installation and supervise initial start-up of the equipment.

C. Contractor shall verify that the pumps are operating at the design duty condition, and shall remove and replace units that do not meet the design operating criteria.

D. For all pump tests, ensure that the force main is full of liquid during the testing. The Contractor shall provide the necessary water and other materials required for the testing as defined herein and recommended by the manufacturer.

E. The manufacturer's representative shall provide written certification that the installation is correct and that the equipment has operated satisfactorily, verifying the complete assembly for proper alignment and connection, and quiet operation. This service shall be provided for a minimum period of one trip and one day. After the installation and operation of the equipment has been certified, the manufacturer's representative shall train the Owner's personnel in the proper operation and maintenance of the equipment. The Owner may videotape the training.

F. A start-up report, acceptable to and approved by the Engineer, shall be completed by the manufacturer’s representative before final acceptance of the pumps.

3.4 FIELD QUALITY CONTROL

A. Provide manufacturer's certifications verifying proper installation and operation of the pumps and pump assemblies.

B. Replace pumps and assemblies that fail testing or are otherwise damaged at no additional cost to the Owner.

C. The Contractor shall bear all costs of field tests, including related services of the manufacturer’s representative.

END OF SECTION