City of Veneta
Lane County, Oregon

Contract Documents

Volume 2- Technical Specifications

FOR THE CONSTRUCTION OF

Jack Kelley Drive Lift Station

March 2018
Project No. 3101-010
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SECTION 01010 – SUMMARY OF THE WORK

PART 1   GENERAL

1.01   SUMMARY

A. The Contractor shall furnish all labor, equipment, and materials necessary to complete all work in accordance with the Contract Documents.

B. The work shall be performed in the City of Veneta, Lane County, Oregon. Veneta is located on Highway 126, 14.4 miles west of Eugene.

C. The Project Scope is briefly described below:

1. The project site is located on the eastside of Lot 600 on Jack Kelley Drive. A completed working lift station including but not limited to:

   a. Obtain permits as required from ODOT and The Port of Coos Bay Railroad.

   b. Construct 4,200 linear feet of 15-inch PVC gravity line.

   c. Construct manholes as required and shown on Plans.

   d. Construct working lift station as shown on Plans.

   e. Construct 8’ diameter wet well 26’ deep

   f. Furnish and install two submersible centrifugal pumps, guide rails, VFD’s, controls and appurtenances.

   g. Furnish and install above grade ductile iron pipe, valves, fittings, and flow meter.

   h. Furnish and install generator and automatic transfer switch.

   i. Electrical installation including buried conduit, power and control wire, panels, power supply and other as required for a complete operational installation.

   j. Construct CMU electrical/control building with slab-on-grade foundation, additional concrete site work as identified on Plans.

   k. Construct 4,300 linear feet of 10-inch HDPE force main and connect to working lift station as shown on Plans.

   l. Demolition and Removal of existing Jeans Road Lift Station

   m. Abandonment of gravity lines as identified on Plans.

   n. Connect force main to headworks at the City’s wastewater treatment plant as shown on Plans.

   o. Provide temporary pumping facilities to be used as required to maintain operation of existing sewer lines and pump station during construction.
D. Work shall not begin on any part of this project until Engineer has issued the Notice to Proceed to the Contractor.

1.02 PROJECT INSPECTION

A. Project inspection will be provided by Civil West Engineering Services, Inc.

B. The Project Inspector will perform inspection services as the Project Engineer's authorized representative. However, all engineering decisions will be made by the Project Engineer or Project Manager.

C. At completion of the project, the Project Inspector will certify in writing to the Owner and the Department of Environmental Quality (Department) that construction was inspected by him and found to be in accordance with the Plans and Specifications, including any changes therein approved by the Engineer and Department.

D. Record Drawings will be prepared at the conclusion of construction activities.

1.03 WORK PROGRESS

A. It is the intent of these Contract Documents that the Work precedes in a systematic manner so that a minimum of inconvenience to the public and district personnel results in the progression of the work. Suitable equipment will be required to properly execute the work with the least amount of disruption to services and access through the work area. Contractor shall contain operations to within the designated public properties, rights-of-way and within any construction easements obtained for this project.

B. Order and schedule delivery of materials in ample time to avoid delays in construction. If any item is found to be unavailable, notify the Engineer immediately to permit the Engineer's selection of suitable substitute. Timely delivery of all materials and equipment is Contractor's responsibility. No extensions in Contract Time will be allowed due to delays caused by late delivery of items. Availability of items should be determined during bidding.

C. The Contractor shall protect the work and materials from damage due to the nature of the work, the elements, carelessness of others, or from any other cause until the completion and final acceptance of the work. All loss or damage arising out of the nature of the work to be done under these Contract Documents, or from any unseen obstruction or defects which may be encountered in the execution of the work, or from the action of the elements, shall be sustained by the Contractor.

D. The Contractor shall remove completely all materials designated for removal, to the extent specified and/or indicated in the drawings. For such materials, removal, hauling, disposal (including providing disposal location), and applicable precautions are entirely the Contractor's responsibility. Allow no excess accumulation of non-reusable material at job site(s).

E. Contractor is responsible for the protection of all existing improvements that are to remain in place. This includes, but is not necessarily limited to: existing utilities (water, sewer, gas, electric, phone, etc.), roads, driveways, drainage ditches, culverts, fencing, shrubbery, and all landscaping structures and vegetation. Temporary enclosures, walls, covers, or other protection shall be provided and maintained by the Contractor as required. Contractor shall cooperate with the owners of such improvements, and shall restore and/or replace all damaged items as directed, without any additional expense to the Owner or payments to the Contractor.
F. The location and depth shown on the drawings for the existing underground facilities are approximate only and are not guaranteed to be accurate or complete. As-builts are not available for existing improvements.

G. Existing water meters, clean outs and other utility locations are not specifically indicated on the plans but do exist throughout the project, the contractor shall field locate all utilities prior to the start of construction. Pothole all utility crossings prior to construction as necessary to avoid conflicts. Contractor shall keep existing utilities in service and protect them during construction. Contractor is responsible for any damage to existing utilities. Portions of utilities which are to be abandoned in place may be removed by the contractor to the extent necessary to accomplish the construction.
SECTION 01025 – MEASUREMENT AND PAYMENT

PART 1  GENERAL

1.01  SUMMARY

A. Wherever in these Specifications an article, device or piece of equipment is referred to in the singular, such reference shall include as many such items as are shown on the Drawings or are required to complete the installation.

B. Miscellaneous items required in the project that do not have a corresponding Section in the Bid Form are to be considered incidental costs to the project. Compensation for such items and/or work shall be incorporated into other related bid items or total costs. No separate measurement and payment will occur for such incidental costs.

C. Monthly progress payments and final payment will be made in accordance with the Contract and the General Conditions. A portion of all progress payments will be withheld as “retainage” in accordance with the General Conditions.

D. Additional detail on measurement and payment may be found in other Sections detailing specific items. If no payment information is provided in specific sections, payment for materials or workmanship shall be included with the related items on the bid form for each part of the project.

E. Payment is provided for each bid set, schedule and alternate shall be provided as outlined on the bid form for each.

1.02  UNIT PRICES

A. Payment will be made on a unit price basis according to the prices provided by the Contractor in the accepted Bid Form (Proposal). Payment will be made for the actual quantity of individual items (units) incorporated and installed in the project.

1.03  LUMP SUMS

A. Payments on lump sum contracts and/or bid items will be made based on the percentage of work complete at the end of the particular payment period.

B. Percentage of work complete will be recorded and submitted by the Contractor and estimated by the Engineer based on inspection. Payment will be based on the Contractor’s approved schedule of values.

1.04  PROGRESS PAYMENTS

A. Monthly progress payments will be made as set forth in the Agreement, in accordance with the General Conditions and Supplementary General Conditions.

B. At the stated day of the month, submit a monthly payment request in accordance with the General Conditions and Supplementary General Conditions. Base request on actual quantities installed and completed, and/or approved schedule of values with percent complete of each item. Show payment requested for each item, and total payment requested.
C. Engineer will review payment requests and compare with inspection records to verify quantities and completed items. Engineer will recommend payment amounts for Owner approval and payment.

END OF SECTION
SECTION 01028 – CHANGE ORDER PROCEDURE

PART 1 GENERAL

1.01 SUMMARY

A. Make such changes in the Work, in the Contract Sum, in the Contract Time of Completion, or any combination thereof, as described by Change Orders signed by the Owner, Engineer, and the Contractor. All change orders shall be authorized by the Funding Agency, if different then the Owner.

B. See also applicable sections of the General Conditions.

C. Work outside the scope of the original Contract Document intent will not be paid for by Owner or Engineer unless an approved Change Order precedes such work.

1.02 PROCESSING CHANGE ORDERS

A. Change Orders will be numbered in sequence and dated. The Change Order will describe the changes and will be signed by the Owner, Engineer and the Contractor. Request for estimates for possible changes are not to be considered Change Orders or direction to proceed with the proposed changes.

B. Change Orders will be prepared by the Engineer. All change orders shall be authorized by the Funding Agency.

C. Contractor may request that the Owner consider a Change Order by sending a written Change Order Request to both Owner and Engineer to initiate the Change Order process. Any increase in cost or time requested by Contractor shall be reasonable and based on the provisions in the Contract Documents.

D. When requested, Contractor shall provide written evidence substantiating cost changes including receipts, cost proposals from suppliers, and wage forms showing labor used for a particular change.

E. Change Orders will be processed using the form shown in these Contract Documents.

F. Change Order's may include changes for costs, time, material selections, or other changes to the Contract Documents as necessary.

END OF SECTION
SECTION 01040 – COORDINATION

PART 1    GENERAL

1.01 SUMMARY

A. Restrict work to within public rights-of-way and easements obtained for this project.

B. The Contractor shall coordinate his work with the following:
   1. City of Veneta
   2. Emerald People’s Utility District (EPUD)
   3. Oregon Department of Transportation (ODOT)
   4. NW Natural Gas
   5. Verizon, Century Link and Charter Communications or other affected communications
   6. Port of Coos Bay
   7. Department of State Lands (DSL)
   8. Private Property Owners and general public
   9. Other affected utilities and agencies

C. Permit and maintain access for the Owner and/or residents to any adjacent facilities that are not part of work included within the project.

D. Coordinate with Owner to determine the locations of underground piping, vaults, valves and other items that could be damaged during construction.

E. Restoration and cleanup work shall be completed with each phase of the construction project. Parking lots and properties shall be maintained and kept clean and clear of excess excavation, debris, dirt and other materials.

END OF SECTION
SECTION 01046 – PROTECTION OF EXISTING IMPROVEMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Where Contractor's operations are near utility systems, structures, or are adjacent to other property, no work shall be started until Contractor has made all arrangements necessary for protection thereof have been made. Contractor shall exercise all possible precautions to prevent damage to existing structures, improvements, and underground utilities which are to remain.

B. Approximate locations of known underground utilities are shown on the Plans. Exact location or extent of such utilities is not guaranteed, and utilities may exist which are not shown on the Plans. Contractor shall call for utility locates prior to any digging. Contractor shall also pothole as required ahead of the work to verify the location and depths of affected utilities. No additional compensation will be given for such work or for utilities being different from shown on the plans.

1. All trench excavations and structure excavations within two (2) feet of any existing underground utility shall be performed by hand methods in accordance with state laws.

C. The Contractor shall be solely and directly responsible to the owner's and operator's of such properties and services for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage which may result from the carrying out of the work to be done under this Contract.

D. Restoration of Existing Improvements. Except as shown on the Plans or as provided elsewhere in these specifications, the Contractor shall, at their own expense, repair and/or replace all utilities, services, landscaping, structures, substructures and other improvements damaged by the operations associated with this project, as directed. These repairs and replacements shall all be suitable and proper for intended use and in every respect acceptable to the Owner, Engineer and appropriate governing body or owner of such improvement. At minimum, restoration will be required to match the existing adjacent structure/improvement in thickness, finish, quality, quantity, and aesthetics.

E. In the event of interruption of domestic water, electric, telephone, sewer, or other utility services, the Contractor shall promptly notify the proper authority and the Owner. The Contractor shall cooperate with the proper authority in restoration of service as promptly as possible and shall bear all costs of repair. In no case shall interruption of any water, sewer, or utility service be allowed to exist outside working hours unless prior approval is received from said authority and Owner.

F. The Contractor shall pothole existing waterlines or other utilities ahead of his work so that potential conflicts can be minimized or that minor relocation of the new waterline routes can be made. Potholing is defined as exploratory excavation of existing waterlines or other utilities to verify their depth and location.

1.02 INTERFERING STRUCTURES, IMPROVEMENTS AND LANDSCAPING

A. It shall be entirely the responsibility of the Contractor to locate and protect all existing structures, landscaping, and other improvements in advance of the work. Neither the
Owner, Engineer, nor any of their officers or agents shall be responsible to the Contractor for damages as a result of any structures or improvements being located differently than indicated in the drawings, nor which exist and are not indicated on the drawings.

B. If interfering power poles, telephone poles, guy wires, or anchors are encountered, the Contractor shall notify the affected utility and the Engineer at least seven (7) days in advance of construction to permit arrangements for protection or relocation of the structure. However, failure of utility to respond shall create no obligation on Owner, and Contractor shall protect all utilities against damage, or shall stand all costs involved thereof.

C. Landscaping, Tree and Plant Protection. Provide adequate protection of existing landscaping against damage from construction operations, including all structures and vegetation. Protect roots, trunk and foliage of existing and new shrubs and trees from all damage including that possible from compaction and dust. Contractor shall be entirely responsible to remove and replace all property which is damaged by work related to the project. Contractor shall bear all costs associated with replacement of existing landscaping, and shall cooperate with the owner of such improvements, the Owner, and the Engineer in all protection and restoration/replacement that is required. In specific circumstances, Contractor may make special arrangements with property owners for removal of landscaping without replacement. Copies of written agreements for all such arrangements shall be furnished to the Engineer.

D. When construction operations will affect the property of a private citizen (such as driveways, landscaping, etc.), even when such improvements are in the road right-of-way, the Contractor shall notify the owner of such property and the Owner, at least seven (7) days in advance of any affecting Work, so that any desired preparations can be made.

1.03 ROADS AND ACCESS

A. All work shall be conducted to minimize damage to existing roadways, easements and parking lots, including limiting wheel loads to acceptable levels. At all times keep roadways, shoulders, and ditches free from excess materials and debris.

B. Spillage of soil, dust, rock, mud, etc. on all roads (including State, County, City and private roads) used by the Contractor (and any working for Contractor) during construction, shall be prevented as much as possible. If spillage cannot be prevented, an hourly patrol shall be provided by the Contractor to police and sweep clean all spillage. At the conclusion of each workday, such traveled areas shall be left completely clean and free from all extraneous materials. Contractor is entirely responsible to prevent such spills and follow all related laws and regulations. If spillage of hazardous material occurs, Contractor shall immediately notify the proper authorities and remove the spill in the proper manner. Owner will not be liable for any additional costs due to spillage of any kind.

C. All damaged gravel, concrete and/or asphaltic concrete surfaces shall be repaired as required to conditions acceptable to the governing body and Engineer. No cleated or crawl-type equipment shall be operated on paved surfaces, except to cross a road when adequate protection of the surface is provided.

D. During construction the Contractor shall take necessary measures to avoid and abate excessive dust. Sprinkling of roadways and sites may be necessary and shall be conducted carefully to avoid over wetting while keeping dust to a minimum.

E. Contractor is responsible for constructing, maintaining, and removing any additional access that Contractor deems necessary for the Work. Contractor must notify Owner
and Engineer, and must obtain written consent from the governing body, prior to construction of additional access not shown on the drawings. All applicable regulations shall be followed in such access construction, including obtaining any required permits.

END OF SECTION
SECTION 01050 – FIELD ENGINEERING

PART 1   GENERAL

1.01 SUMMARY

A. Construction stakeout – Stakeout will be provided by the Engineer and Engineer’s Surveyor. A single set of staking will be provided to establish line and grade for each major improvement. Staking requests shall be coordinated with and approved by the Engineer.

B. The Contractor will be solely responsible for laying out the work from the information/staking provided and no additional stakeout will be provided except at the expense of the Contractor.

C. It shall be the responsibility of the Contractor to maintain and preserve the construction stakeout as provided. The Contractor will not be allowed time extensions or damages caused by the loss of control stakes. If control is lost and/or disturbed and in the judgment of the Engineer requires replacement, such replacement will be at the expenses of the Contractor.

D. It is expected that minor revisions of the stakeout may be required during the course of construction. These revisions and modifications shall be made only as directed by the Engineer. The Contractor shall not be entitled to any additional compensation for minor revisions or modifications.

E. Contractor shall maintain proper equipment on site as necessary to ensure horizontal and vertical control and proper location of improvements.

END OF SECTION
SECTION 01060 – REGULATORY REQUIREMENTS

PART 1   GENERAL

1.01 SUMMARY

A. The Contractor shall at all times observe and comply with all federal and state laws and lawful regulations issued and local laws, ordinances and regulations which in any manner affect the activities of the Contractor under this contract and further shall observe and comply with all orders or decrees as exist as present and those which may be enacted later by bodies or tribunals having any jurisdiction or authority over such activities of the Contractor.

B. The contractor shall be responsible and liable for all accidents, damage or injury to any person or property resulting from any activity, duty and obligation of the Contractor under this Contract for which the Contractor may be legally liable. The contractor shall hold blameless and harmless and shall indemnify the Owner and its officers, employees against any and all claims, demands, loss injury, damage, actions and cost of actions whatsoever which they or any may sustain by reason of any act, omission or neglect of the Contractor or employees, agents, representatives or assignees of the Contractor in connection with the activities, duties and obligations of the Contractor under this Contract.

END OF SECTION
SECTION 01100 – REFERENCE STANDARDS

PART 1   GENERAL

1.01 SUMMARY

Abbreviations and Acronyms. Whenever the following abbreviations are used in these specifications or in the drawings, the following definitions apply. Unless otherwise designated, all reference to the following standards, specifications and methods shall imply the latest adopted revision in effect at the time of bid opening. Such standard, except as modified herein, shall have full force and effect as though printed in the specifications.

A. AASHTO American Association of State Highway and Transportation Officials
B. ACI American Concrete Association
C. AIA American Institute of Architects
D. AISC American Institute of Steel Construction
E. ANSI American National Standards Institute
F. APWA American Public Works Association
G. ASCE American Society of Civil Engineers
H. ASME American Society of Mechanical Engineers
I. ASTM American Society of Testing Materials
J. AWWA American Water Works Association
K. EPA United States Environmental Protection Agency
L. DEQ Department of Environmental Quality (both Federal and State)
M. DWP Oregon Dept. of Human Services, Drinking Water Program
N. FM Factory Mutual
O. NEC National Electric Code
P. NEMA National Electric Manufacturers Association
Q. NFPA National Fire Protection Association
R. NSF National Sanitation Foundation
S. OAR Oregon Administrative Rules
T. ODOT Oregon Department of Transportation
U. ORS Oregon Revised Statutes
V. OSHA Occupational Safety and Health Act (both Federal and State)
W. UL Underwriters' Laboratories
X. USDA United States Department of Agriculture
Y. SSPC Steel Structures Painting Council or, The Society for Protective Coatings

1.02 The abbreviation of “N.I.C.” if shown on the plans or specifications represents work that is “Not in Contract”. This work is to be completed at a later date by Owner or others and for which the Contractor will not be responsible.

END OF SECTION
SECTION 01300 - SUBMITTALS

PART 1  GENERAL

1.01  SUMMARY

This section outlines in general the items the Contractor must prepare or assemble during the progress of the work, including technical submittals, O&M data, record drawings, and substitution requests. Submittals are required for each piece of equipment or material even when the item being proposed for use is the same as specified.

1.02  RELATED SECTIONS

A.  General Conditions
B.  Section 01630 – Product Substitutions
C.  Section 01700 – Closeout Submittals
D.  Section 01730 – Operation and Maintenance Manuals
E.  Section 01780 – Record Drawings
F.  Section 02446 – Horizontal Directional Drilling
G.  Section 02450 – Bore-Jack Casing Placement
H.  Various sections requiring submittals for equipment and materials

1.03  BASIS OF DESIGN

A.  In some cases, elements of the improvements are based around a specific supplier of equipment. This should not be construed as an effort to sole-source or exclude other equipment suppliers from being considered in the bid process.

B.  However, it should be understood that individual equipment items may vary slightly from one manufacturer to another. If a proposed piece of equipment varies enough from the equipment utilized in the basis of design, changes to other aspects of the system may be required. This could include, but not be limited to:

1.  Head loss calculations and hydraulic grade adjustments.
2.  Structural changes.
3.  Electrical changes.
4.  Mechanical Changes.
5.  Grading changes.

C.  When submitting equipment that is appreciably different from the basis of design, the Contractor must take care to consider the impacts to the project and what changes to the design, if any, will be required to utilize a proposed piece of equipment.
D. If required as a result of utilizing equipment that varies appreciably from the basis of design, Contractor shall include in the submittal the following:

1. Updated drawings showing the layout, plan, elevations, and other views to illustrate the alternative equipment choice and how it fits into the project.

2. Updated engineering information on the hydraulic grade calculations, treatment performance, or other design considerations for review to confirm the proposed equipment meets the intent of the specifications.

3. Updated mechanical, structural, electrical, and other plans, as required, for changes brought on by an equipment selection that varies from the basis of design.

4. Any other information, required by the Engineer, to review the impact of the proposed equipment on the overall process and design and to confirm that the Contractor has adequately vetted the equipment and is prepared to construct the improvements with the selected equipment.

E. The costs of the submittal process described above shall be included in the Contractor’s bid price for the improvements. No separate payment will be made to prepare drawings or update the design.

F. The Engineer will provide the Contractor with AutoCAD files to assist them in the submittal process upon request.

1.04 SUBSTITUTION REQUESTS

A. Refer to the General Conditions, 7.05 regarding substitutions, the costs of review, and the responsibility of the Contractor relating to substitution requests.

B. Where the specifications state “or-equal”, “or approved equal”, or similar statement, the Engineer alone will determine if the proposed substitute item is allowed.

C. Requests for substitution for items specified by manufacturer or manufacturer's model number as specified throughout the Contract Documents shall be in writing and be accompanied with sufficient information to allow the Engineer to identify the nature and scope of the request. Information to be provided shall include.

D. Reason the substitution request is being made.

E. All submittal information required for the specified item or equipment, including all deviations from the specified requirements necessitated by the proposed substitution.

F. Reproducible contract drawings, marked up to illustrate the alterations to all structural, architectural, mechanical and electrical systems required to accommodate the proposed substitution.

G. If the substitution requires any mechanical, electrical or structural changes, the Contractor will be responsible for costs in evaluating a requested substitution. The cost for such an evaluation will be determined on a case-by-case basis, after receipt of written request. The Engineer will notify the Contractor in writing of said cost. If the Contractor wishes to proceed, he shall advise the Engineer in writing and submit additional information as may be requested. Final approval of a substitution must be made by both the Engineer and Owner.
H. No additional costs of any kind will be incurred by the Owner or Engineer by approval or rejection of any substitution request.

1.05 SUBMITTALS

A. Technical submittals

1. Technical submittals covered by these specifications include manufacturer's information, shop drawings, test procedures, test results, samples, request for substitutions and miscellaneous work related submittals. Submittals shall also include, but not be limited to, all mechanical, electrical and electronic equipment and systems, materials, reinforcing steel, fabricated items, piping and conduit details, and lead time required for delivery to job site.

2. Contractor's Responsibilities

a. The Contractor shall furnish all drawings, specifications, descriptive data, certifications, dimensional drawings, samples, tests, methods, schedules and manufacturers installation and other instructions as required by the contract documents, or the Engineer, to demonstrate fully that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the contract documents.

b. The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment or method of work shall be as described in the submittal. The Contractor shall verify that all features of all products conform to the specified requirements.

c. The Contractor shall ensure that there is no conflict with other submittals and notify the Engineer in each case where his submittal may affect the work as shown on the Plans.

d. The Contractor shall coordinate submittals among his subcontractors and suppliers.

e. Submittals shall coordinate with the work so that work will not be delayed. Coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals.

f. The Contractor shall not proceed with work related to a submittal until the submittal process is complete.

g. The Contractor shall certify on each submittal document that he has reviewed the submittal, verified final conditions and complied with the contract documents. The Contractor may authorize in writing a material or equipment supplier to deal directly with the Engineer. This interaction shall be limited to contract interpretations to clarify and expedite the work.

h. Charges will be documented and the Contractor will be charged for review of multiple non-conforming submittals for any one (1) item in excess of two (2) times.

1.06 RECORD DRAWINGS
A. During the course of construction, Contractor shall maintain a marked-up set of the project drawings. See Section 01780.

1.07 OPERATION AND MAINTENANCE (O&M) MANUALS

A. Contractor shall collect O&M data from all equipment and material suppliers for all items provided in the project. See Section 01730.

1.08 ENGINEER’S REVIEW

A. Review shall not extend to means, methods techniques, sequences or procedures of construction, or to verify quantities, dimensions, weights or gages, or to fabrication processes, except when specifically indicated or required by the contract documents, or to safety precautions or programs.

B. The Contractor shall submit five (5) copies of all submittal material to Engineer. Two (2) copies will be returned upon final approval. If the submittal is rejected four (4) copies will be returned.

C. Unless otherwise specified, within 14 calendar days after receipt of submittal, the Engineer will return the marked-up copies. The Contractor shall take appropriate action if the submittal needs to be resubmitted. If specified submittal material is to be used for O&M data, all corrections shall be made and new clean copies shall be submitted with the O&M data.

D. Review of contract documents, method of work or information regarding materials or equipment the Contractor proposes to provide, shall not relieve the Contractor of his responsibilities for errors therein and shall not be regarded as an assumption of risks or liability by the Engineer or Owner. The Contractor shall have no claim under the Contract on account of failure or partial failure of the method of work, material or equipment so reviewed.

END OF SECTION
SECTION 01310 – CONSTRUCTION PROGRESS SCHEDULES

PART 1 GENERAL

1.01 SUMMARY

A. Provide a progress schedule indicating the times for starting and completing the various stages of Work, including any Milestones.

B. As work progresses, Contractor shall prepare and submit updated progress schedules as necessary.

C. Schedule duration of each activity shall be based on the Work being performed during the normal 40-hour work week with allowances made for legal holidays and normal weather conditions.

D. Updates – Schedule shall be updated at least once per month as required to maintain accuracy.

1.02 SUBMITTALS

A. Within 10 days after the date of the Agreement (Contract), Contractor shall submit a proposed progress schedule to the Owner and Engineer for approval.

B. Interim Schedule

1. Contractor shall submit to the Engineer within 10 days after award of Contract, but before any scheduled pre-construction conference, an Interim Schedule setting forth all activities for the first two (2) months of construction.

2. Review comments by the Engineer concerning the Interim Schedule shall be considered in developing the Overall Schedule.

3. The Contractor shall submit three (3) copies of the Interim Schedule to the Engineer.

C. Overall Schedule

1. For Contract Periods exceeding 60 days, the General Contractor shall prepare and submit, within 30 days after the award of Contract, an Overall Schedule composed of all construction operations in connection with the Contract.

2. Overall Schedule, if it is sufficiently developed to equal or exceed the Interim Schedule requirements, may be submitted in lieu of a separately prepared Interim Schedule. In any event, the Interim Schedule shall form the basis for the Overall Schedule and will be considered an integral part of the Overall Schedule.

3. Contractor shall submit three (3) copies to the Engineer for his review. Within seven (7) days after receipt of the submittal, the Engineer will review the submitted
schedule and return one copy of the marked-up original to the Contractor. If the Engineer finds that the submitted schedule does not comply with specified requirements, the corrective revisions will be noted on the submittal copy and returned to the Contractor for corrections and resubmittal.

1.03 SCHEDULE CONTENT

A. Schedules shall indicate the sequence of work and the time of starting and completion of each activity. Activities shall include, but not be limited to, the following items as they pertain to the Contract:

1. Each subcontractor’s items of work
2. Temporary provisions for continued service
3. Installation of specific major items
4. Submittals from Contractor to Engineer for review and return to the Contractor. Material and equipment order, manufacture and delivery
5. Dates for performance of all testing procedures
6. Dates for tie-ins to existing systems
7. Final cleanup and Start-Up
8. Allowance for inclement weather
9. The schedule duration of each activity shall be based on the work being performed during the normal 40-hour work week with allowances made for legal holidays and normal weather conditions.
10. Schedule shall be updated each month as required, and more often if changes in scheduling are required or if the original schedule is no longer valid.
11. After each revision, the Contractor shall submit the revised schedule to the Engineer.
12. The Contractor shall consider all critical systems and coordinate existing, temporary, and new construction to ensure continuous sewer services.

1.04 PROGRESS OF WORK

A. The Contractor shall execute work with such progress as necessary to prevent delay to the overall completion of the project and with such forces, materials and equipment to assure completion in the time established by the Contract.

B. The Contractor may find it necessary to work overtime, double shifts, weekends and/or holidays if such a schedule is required to complete the project within the time allowed. Such work will be performed at the Contractor’s expense.

END OF SECTION
SECTION 01400 – QUALITY CONTROL

PART 1   GENERAL

1.01   SUMMARY

A. Work shall conform to these specifications and the standards of quality contained herein.

1. Only new items of recent manufacturer and quality specified, free from defects, will be permitted on the Work, unless items are specifically noted as existing to be reutilized. Remove rejected items immediately from the Work and replace with items of quality specified. Failure to remove rejected materials and equipment shall not relieve the Contractor from responsibility for quality and character of items used, nor from any other obligation imposed by the Contract.

2. No work defective in construction or quality, or deficient in any requirement of the drawings and specifications will be acceptable in consequence of the Owner's or the Engineer's failure to discover or to point out defects or deficiencies during construction; nor will the presence of Resident Project Representatives on the work relieve the Contractor from responsibility for securing the quality and progress of work as required by the Contract. Defective work revealed within the time required by guarantees shall be replaced by the Contractor by work conforming to the intent of the Contract. No payment, whether partial or final, shall be construed as an acceptance of defective work or improper materials.

END OF SECTION
SECTION 01500 – TEMPORARY FACILITIES AND CONTROLS

PART 1   GENERAL

1.01 SUMMARY

A. This section includes mobilization, temporary utilities, temporary construction, safety requirements, temporary environmental controls, and other temporary controls.

B. Submittals

1. Plans for disposal of waste materials and excavated material not required for fill, include permits as required.

C. Permits

1. Contractor shall secure and pay for all permits and fees required pertaining to temporary facilities and all other work.

D. Mobilization shall include de-mobilization and consist of preparatory work and operations, including but not limited to, those necessary for the movement of personnel, equipment, supplies and incidentals to and from the project site; for the establishment of offices, buildings and other facilities necessary for work on the project; for premiums on bond and insurance for the project, and for other work and operations which the Contractor must perform or costs he must incur before beginning work on the project and after completion of the project.

E. Access of Government Officials. Authorized representatives of the Federal, State and Local Governments shall at all times have safe access to the Work, whenever in preparation or in progress, and Contractor shall provide proper facilities for such access and inspections.

1.02 MATERIALS

A. Contractor shall provide all materials necessary for all work in this Section.

1.03 WORKMANSHIP

A. During all construction operations, the Contractor shall construct and maintain such facilities as may be required to provide access by all property owners to their property. No person shall be cut off from access to their place of business or residence, unless the Contractor has made special arrangements with the affected persons and has notified Engineer and Owner. The Contractor upon completion of the Work shall remove all temporary facilities.

B. Temporary Utilities

1. Electric Power

a. Electrical power. The Contractor, for any special power needs should confirm power requirements. Arrangements for power shall be the responsibility of the Contractor.
C. Sanitary Facilities

1. The Contractor shall provide chemical toilets of suitable types and maintain them in a sanitary condition at all times, conforming to code requirements and acceptable to the health authorities. They shall be of watertight construction so that no contamination of the area can result from their use. Arrangements shall be made for frequent emptying of the toilets. Upon completion of the work, toilets shall be removed and the area restored to its original condition.

2. Portable toilet facilities shall be located only at locations approved by the Owner.

D. Safety Requirements

1. Proper traffic control shall be provided in accordance with Section 01570.

2. Access for Police, Fire, and School Bus Service

   a. Notify the fire department, police department and, when applicable, the School District before closing any street or portion thereof, and no closing shall be made without the Engineer's approval. Notify said departments when the streets are again passable for emergency vehicles. Do not block off emergency vehicle access to any area, such as consecutive arterial crossings or dead-end streets, in excess of 300 linear feet, unless the Contractor obtains special written permission from the chief of the fire department. Conduct operations so as to cause the least interference with any fire station access and at no time prevent such access.

   b. The Contractor shall furnish a list of emergency telephone numbers to both the Engineer and the Owner so that contact may be made easily at all times in cases of emergencies.

3. Fire Prevention. Contractor shall perform all work in a fire-safe manner. Contractor shall supply and maintain on site all fire-fighting equipment, supplies, and capable personnel for extinguishing incipient fires as required by all Federal, State and local laws and regulations. Each piece of internal combustion engine-driven equipment shall be equipped with a fire extinguisher in accordance with the appropriate recommendation of the National Fire Protection Association (NFPA). All engines shall be equipped with functional spark arrestors and sound suppression devices.

E. Temporary Environmental Controls

1. The Contractor shall maintain affected areas from his construction free from environmental pollution that would be in violation of federal, state or local regulations.

2. Air Pollution Control

   a. Minimize air pollution likely to occur from construction operations by wetting down bare soils to control dust and requiring proper combustion emission control devices on construction vehicles.

   b. Give unpaved streets, roads, and detours or haul roads in the construction area a dust preventative treatment or periodically water to
prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.

3. Water Pollution Control and Erosion Control
   a. Erosion control measures shall be maintained as necessary to ensure their continued effectiveness.
   b. Dispose of water removed during dewatering in accordance with local and state laws.
   c. Petroleum products, chemicals, or other deleterious materials shall not be allowed to enter the water.

F. Material Transport Issues (Haul)
   1. The Contractor shall be responsible for the planning and execution of the import and export of material to and from the project sites. This will include planning the routes, traffic control, roadway cleanup, and any permitting that may be required.
   2. The Contractor will plan routes that will avoid creating negative traffic impacts whenever possible.
   3. The haul routes shall be maintained and kept free of dirt, dust, and other debris that will result in unfavorable conditions for the residents of the area. The contractor shall sweep, wash, and otherwise clean the local routes, on a regular basis, if tracking of dirt on the roadways cannot be avoided.
   4. The Contractor shall seek to keep heavy equipment off the roads, including track driven equipment, in an effort to avoid damage and breakup of local pavement structures. The Contractor will be responsible for the repair of roads that are damaged due to negligence or if the damage could have been avoided. Care shall be taken to avoid allowing dirt, gravel, sand, or other deleterious materials from entering storm drains, ditches, and waterways.
   5. Temporary roads, parking, site access, and staging areas
   6. The Contractor shall submit plans describing the plan for accessing the site, any temporary roads that will be, and staging and spoil areas.
   7. Parts of the project site are encumbered by wetlands and must not be impacted. Any damage to or encroachment into wetland areas will be the responsibility of the Contractor including all reporting, cleanup, mitigation, and fines that may be required by the interested agencies.
   8. Staging of materials and equipment can take place on or near the site. The Contractor should carefully consider the location for staging of materials and equipment and ensure that wetlands are not impacted or encroached upon. If necessary, the Contractor will secure off-site staging and storage areas near the site. The Contractor will be responsible for any rent, payment, or agreements made with other land owners for this purpose.

G. Material Storage and Handling Provisions
1. The Contractor shall make provisions for the storage and handling of all materials and equipment to be used on the project. This shall be done in such a way to protect and preserve the materials and equipment until they can be installed.

2. When needed, provisions shall be made to keep materials dry and out of the weather. Alternatively, some materials should be protected from UV exposure. Regardless of the material or equipment, care should be taken to protect and preserve them in like new condition.

3. Handling of materials and equipment shall also be done in such a way to protect them from damage, neglect, or harm. Appropriate methods to strap, tie-down, cushion, cover, or otherwise protect the material when being moved or handled shall be employed.

4. The Engineer shall review and inspect the provisions for material storage and handling. If any material or equipment is determined to be damaged or in any other condition than new, the Contractor shall repair or replace the material or equipment before it is installed on the project.

1.04 MEASUREMENT AND PAYMENT

A. Payment for this item shall be on a lump sum basis at the amount stated on the Bid Form for “Mobilization, Overhead, Bonds” and shall include all activities related to mobilization and demobilization on the project, insurance and bonding costs, costs related to scheduling, coordination, submittals, preparatory work, temporary construction facilities, project offices, miscellaneous equipment, project closeout, building permits (as required), other agency fees, other facilities and equipment necessary and all other Division 1 activities within the scope of work not designated with individual payment items for work on the project.

B. Construction Facilities and Temporary Controls - Payment for work in this item shall be on a lump sum basis at the amount stated on the Bid Form and shall include all temporary construction facilities, project offices, miscellaneous equipment, costs related to scheduling, coordination, submittals, and all other Division 1 activities within the scope of work not designated with individual payment items shall be included within this item.

END OF SECTION
SECTION 01570 – TRAFFIC REGULATION

PART 1  GENERAL

1.01 SUMMARY

A. This section includes traffic control related safety requirements as may be required for the project.

B. Contractor shall comply with all rules and regulations of County, State, City, and Federal authorities regarding the closing, detouring, and loading of all public streets or highways.

C. No road (public or private) shall be closed or detoured by the Contractor to the public, except by express written permission of the Engineer and entity governing such roadways. Traffic must be kept open on all roads and streets where no detour is possible. The Contractor shall, at all times, conduct the work to assure the least possible obstruction to traffic and normal commercial pursuits. The convenience of the general public and residents, safety, and the protection of property is of prime importance and shall be provided for by the Contractor in an adequate and satisfactory manner.

D. Submittals

1. If road closures, lane closures, or detours are required, Contractor shall prepare, and submit for approval a Traffic Control Plan to the appropriate governing body of such road.

2. Contractor shall submit a traffic control plan and signing plan.

1.02 MATERIALS

A. Contractor shall furnish all flaggers, barricades, lead cars, warning signs, lights, signals, etc. as required to comply with regulations and provide safety.

B. All signs, lights, flags and other warning and safety devices shall meet the current ODOT safety manual affecting the location of construction, or to applicable City/County standards.

C. Barricades shall conform to the Standard Specifications for Highway Construction of the State Highway Department affecting the location of construction, or to City or County Standards where applicable.

1.03 WORKMANSHIP

A. Contractor shall, at their own expense, and without further or other order, provide, erect and maintain at all times during the progress or temporary suspension of the work, suitable barricades, fences, signs or other adequate warnings or protection and shall provide, keep and maintain such danger lights, signals, and flaggers as may be necessary or as may be ordered by the Engineer to insure the safety of the public as well as those engaged in connection with the work.

B. Failure of the Engineer to notify the Contractor to maintain barricades, barriers, lights, flares, danger signals, or watchmen, shall not relieve the Contractor from this responsibility. All barricades and obstructions shall be protected at night by signal lights which shall be suitably distributed and kept burning from sunset to sunrise.
shall be of substantial construction and shall be suitably painted to increase their visibility at night.

C. Whenever the Contractor's operations create a hazardous condition, Contractor shall furnish flagmen and guards as necessary, or as directed, to give adequate warning to the public of any dangerous conditions to be encountered. Contractor shall furnish, erect, and maintain approved fences, barricades, lights, signs, and any other devices that may be necessary to prevent accidents and to avoid damage and injury to the public. Flaggers and guards, while on duty and assigned to give warning to the public, shall be equipped with approved red wearing apparel and a red flag which shall be kept clean and in good repair.

D. Contractor shall provide access to private properties at all times, except during urgent stages of construction when it is impractical to carry on the construction and maintain traffic simultaneously. Coordinate all construction activities with the affected property owners.

E. Contractor shall patrol the traffic-control area and reset all disturbed signs and traffic-control devices immediately, and will remove or cover all non-applicable signs during periods not needed.

F. At the end of each day, the Contractor shall leave work in such condition that it can be traveled without damage to the work and without danger to the public.

G. If, in the opinion of the Engineer or other governing traffic authority, traffic control is lacking or otherwise unsafe or deficient, the Engineer may require that all work be halted until the traffic control measures can be improved to an acceptable level.

1.04 MEASUREMENT AND PAYMENT

A. Payment for this item shall be included within the lump sum price for “Mobilization, Overhead, Bonds”. It shall include all activities related to traffic and safety control on the project and preparatory work for work on the project.

END OF SECTION
SECTION 01610 – STORAGE AND PROTECTION

PART 1  GENERAL

1.01 SUMMARY

A. Protect products scheduled for use in the Work by means as described in this Section and as recommended by the manufacturer.

1.02 MANUFACTURER’S RECOMMENDATIONS

A. Except as otherwise approved by the Owner, determine and comply with manufacturers’ instructions on product handling, storage and protection.

1.03 PACKAGING

A. Deliver products to the job site in their manufacturer's original container, with the labels intact and legible.

B. Maintain packaged materials with seals unbroken and labels intact until time of use.

C. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements at no additional cost to the Owner.

D. The Owner may reject as non-complying such material and products that do not bear identification satisfactory to the Owner as to the manufacturer, grade, quality and other pertinent information.

1.04 STORAGE

A. Store materials on-site in coordination with the Owner to provide suitable site access and clearance.

B. Do not store unnecessary materials that will not be incorporated into the work.

1.05 PROTECTION

A. Protect stored materials from moisture and temperature, and unauthorized handling.

B. Provide protection for finished surfaces.

C. Maintain finished surfaces clean, unmarred and suitably protected until accepted by the Owner.

D. Provide proper protection for all workers.

1.06 REPAIRS AND REPLACEMENTS

A. In event of damage, promptly make replacements and repairs to the approval of the Owner and at no additional cost to the Owner.

B. Additional time required to secure replacements and to make repairs will not be considered by the Owner to justify an extension of the Contract Time of Completion.
C. Repair all scratches and damage to painted surfaces promptly with proper color and material.

END OF SECTION
SECTION 01630 – PRODUCT SUBSTITUTIONS

PART 1    GENERAL

1.01 SUMMARY

A. This Section describes procedures for securing approval of proposed product substitutions.

1.02 PRODUCT OPTIONS

A. The Contract is based on standards of quality established in the Contract Documents.

B. See Section 01300 Submittals, and General Conditions for additional information on submittals and substitutions.

C. In agreeing to the terms and conditions of the Contract, the Contractor has accepted the responsibility to verify that the specified products will be available and to place orders for all required materials in such a timely manner as is needed to meet his agreed construction schedule.

D. The Owner has not agreed to the substitution of materials or methods called for in the Contract Documents, except as they may specifically otherwise state in writing.

E. Where materials and methods are specified by naming one single manufacturer or model number, without stating that equal products will be considered, only the material and method named is approved for incorporation into the Work.

F. Where materials and methods are specified by name or product number, followed by the words "or equal approved in advance", materials and methods proposed by the Contractor to be used in lieu of the named materials and methods shall in all ways be equal or exceed the qualities of the named materials and methods. For consideration as an "equal approved in advance", complete detailed submittals (4 copies) must be received by the Engineer at least fourteen (14) days prior to the bid opening date. Approved substitute items will be listed by addendum prior to bid opening.

G. Where the phrase "or equal," or "or approved equal," occurs in the Contract Documents, do not assume that the materials, equipment or methods will be approved as equal unless the item has been specifically so approved for this Work. Prepare detailed submittal and submit to Engineer. Substitutes will not be incorporated into the work unless submittal is approved by the Owner via the Engineer.

H. Submittals shall include all technical information and diagrams as necessary to allow Engineer to evaluate the proposed substitution. Any/all differences between the specifications or specified equipment and the proposed substitution shall be clearly noted in the submittal. Submittals shall clearly indicate the specific model numbers, part numbers, and options of the proposed substitution.

1.03 DELAYS

A. Delays in construction arising because of the time required for approval of substitution requests will not be considered by the Owner as justifying an extension of the agreed Time of Completion.

END OF SECTION
SECTION 01700 – CONTRACT CLOSEOUT

PART 1   GENERAL

1.01  SUMMARY

A. Section includes procedures and requirements for finalizing and closing out the Project(s).

B. Final clean-ups and restorations shall be done prior to requesting final inspections.

1.02  RESTORATION AND CLEAN-UP

A. Upon completion of any portion of the work, promptly remove temporary facilities generated by that portion of the work, including surplus materials, equipment and machinery unless directed otherwise by the Engineer or the Owner. All construction work by the Contractor shall be clean and free of rubbish, dirt, overspray, and extraneous materials to the satisfaction of the Engineer before acceptance of the work.

B. Street/Road Cleanup. All roadways affected during construction shall be cleaned and restored. All ditches and culverts shall be cleaned and re-graded for proper drainage. Culverts broken or damaged by construction activities shall be restored to their original condition and location. Immediately following construction, remove all dirt, mud, rock, gravel, and other foreign material at the completion of the day or as otherwise required by the Engineer.

C. Site Restoration and Cleanup. Restore or replace any ground covering (e.g., bark chips, cinders, gravel, river rock, etc.) to the original condition or better. Replace topsoiled areas, rake and grade to conform to their original contours. Replace any damaged landscaping or plantings to prior conditions in manner acceptable to Owner. Reseed grass areas as approved. Seed and protect any disturbed slopes.

1.03  CERTIFICATIONS

A. Contractor to prepare on Contractor's letterhead with project title and number clearly identified. Submit to Engineer with application for Final Payment.

B. A written certification that Contractor has fully completed the Work in strict compliance with the Contract Documents, and requesting final inspections.

C. Written certification that all subcontractors and suppliers who have furnished work or materials as part of this project have been paid in full.

D. Written certification that Contractor will replace all materials and workmanship that prove defective within one-year after the date of Final Acceptance. Date Engineer signs Final Payment Certificate is date of Final Acceptance and starts the Contractor's one-year guarantee period.

E. Submission of a signed State or Federal approved Wage Certification Form certifying that Contractor has paid not less than the Prevailing Wage Rate as required by law, and that Contractor has timely submitted the required payroll certificates to the appropriate state or federal wage division.

F. One-Year Warranty Inspection. On the 11th month following final project completion and acceptance, Contractor shall be available to be present during the on-site warranty
inspection. Any defects identified in materials or workmanship shall be corrected within 30 days by the Contractor at his own expense.

END OF SECTION
1.01 SUMMARY
   A. This section outlines in general the format and content of O&M Manuals required on the project.
   B. Contractor shall collect O&M data from all equipment and material suppliers for all items provided in the project. Data shall be specific to the actual equipment used with specific model numbers and options highlighted. General cut-sheets that do not clearly indicate the specific parts and options provided on this job will not be accepted.

1.02 RELATED SECTIONS
   A. Section 01300 – Submittals
   B. Section 01700 – Contract Closeout
   C. Various sections requiring operation and maintenance data

1.03 SUBMITTALS
   A. The Contractor shall submit two (2) copies of the complete manuals to Engineer by 50% construction, which will be reviewed, revised and approved prior to start-up per OAR 340-52-0040(4). The manuals will be reviewed by the Engineer. If complete and acceptable without corrections, Engineer will notify the Contractor in writing and one (1) additional set will be sent to the Engineer by the Contractor.
   B. If changes, corrections, or additional information is required, the Engineer will notify the Contractor and may either return one (1) copy, return portions marked-up, or request additional data. Contractor will then resubmit two (2) copies of the corrected manuals. Contractor shall keep copies for their records. This process will continue until Engineer has two complete approved sets.
   C. When the manuals are complete and approved by the Engineer, the Contractor will then provide one (1) additional complete set so that Engineer can retain one set and two sets can be delivered to the Owner.
   D. Final payment will not be issued until all approved O&M manuals are received.

1.04 QUALITY ASSURANCE
   A. Instructions and data shall be prepared by personnel experienced in maintenance and operation of described products.

1.05 FORMAT
   A. Data shall be prepared in the form of instructional manual providing clear information on operational procedures, periodic maintenance requirements, repair procedures, and troubleshooting procedures.
B. Binders shall be commercial quality, 8-1/2 x 11 inch three-ring binders with hardback plastic covers. Maximum binder ring size is 2 inches and multiple volumes will be used as required. Covers shall have a clear outer shell to allow insertion of cover sheet.

C. Each binder shall be identified with a cover that is typed with the title "OPERATION AND MAINTENANCE INSTRUCTIONS", the title of the project, the name of the Owner, and the date of project completion.

D. Each binder shall include a table of contents and tabbed dividers either color coded or with printed labels. Labels shall be permanently affixed. Manual contents shall be arranged by systems and process flow under section numbers and sequence of table of contents.

E. Text shall be manufacturer’s printed data or typewritten data on 20 pound bond paper. Drawings shall be provided with reinforced punched binder tab, bound with text, and folded as necessary to the size of text pages.

1.06 CONTENT

A. The first sheet inside the cover shall provide the title of project; names, addresses and telephone numbers of the Engineer; names, addresses and telephone numbers of the general contractor with the names of responsible parties.

B. For each product or system, provide the names, addresses, and telephone numbers of subcontractors and suppliers, including local sources of supplies and replacement parts.

C. Product Data: Section sheet shall clearly identify specific products, component parts, and data applicable to the installation.

D. Drawings shall supplement product data to illustrate relations of component parts of equipment and systems to show control and flow diagrams.

1.07 MATERIALS AND FINISHES

A. Building products, applied materials, and finishes shall include product data with catalog number, size, composition, and color and texture designations.

B. Instruction for care and maintenance shall include manufacturer’s recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and schedule for cleaning and maintenance.

1.08 EQUIPMENT AND SYSTEMS

A. For each item of equipment and each system, a description of the unit or system component parts, identification of function, normal operating characteristics, and limiting conditions; and performance curves, engineering data and tests, and complete nomenclature and commercial number for replaceable parts.

B. Electrical service characteristics, controls, and communications for panelboard circuits. Color coded wiring diagrams as installed.

C. Operating procedures. Start-up, break-in, and routine normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and any special operating instructions.
D. Maintenance Requirements. Routine procedures and guide for troubleshooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, and checking instructions.

1. Servicing and lubrication schedules and list of lubricants required.
2. Manufacturer's printed O&M instructions
3. Sequence of operation by controls manufacturer
4. Parts lists, illustrations, assembly drawings and diagrams
5. Control diagrams
6. Charts of valve tag numbers
7. List of manufacturer’s spare parts, current prices, and recommended quantities to be maintained in storage
8. Additional data requirements as specified in individual product sections.
SECTION 01740 – WARRANTIES

PART 1   GENERAL

1.01 SUMMARY

A. Installed Materials Warranties. Prior to 75% completion and payment for work under this Contract, the Contractor shall furnish the Owner through the Engineer, all warranty and/or guarantee forms normally furnished by the manufacturer of equipment. Warranty form shall include the specific equipment installed, the duration of the warranty, details of the warranty, and the installer’s name, address and phone number. Installation date will be filled in by the Owner and will coincide with date of substantial completion of the work under this contract. All such warranties shall name the Owner as the warranted party.

B. Attention is directed to various other sections of the Contract Documents where specific material or installation warranties may be required for items specified.

C. Contractor shall guarantee the Work for a period of one (1) year from the date of Final Acceptance. All materials and workmanship that prove defective within the one-year guarantee period shall be promptly replaced or corrected with no additional cost to the Owner. Written certification that Contractor will replace all materials and workmanship that prove defective within one-year after the date of Final Acceptance is required for project close-out and shall accompany application for Final Payment.

END OF SECTION
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SECTION 01780 - PROJECT RECORD DRAWINGS

PART 1   GENERAL

1.01 SUMMARY

A. This section outlines in general the Contractor requirements for preparing and maintaining and record drawings of the project.

B. Contractor shall provide access to the Record Drawings to the Engineer and Owner throughout construction and shall finalize and submit complete record drawings upon completion of the work.

C. Accurate Record Drawings or “As-Builts” are considered extremely important and it shall be entirely the Contractor’s responsibility to maintain a complete and accurate record of all details of the project as he constructs and installs equipment and materials.

D. Engineer or Owner may stop work if it is determined that Contractor is not properly recording details in record drawings and require correction and accurate documentation of all previous work before additional work proceeds.

E. Engineer must accept and approve the drawings prior to recommending final payment.

1.02 RELATED SECTIONS

A. General Conditions

1.03 SUBMITTALS

A. Submit two complete sets of initial marked-up Record Drawings immediately upon completion of construction work. Engineer will review for completeness and either approve or return one set with comments and corrections.

B. If initial submittal required corrections, submit one complete set of corrected marked-up Record Drawings to Engineer with or before request for final payment.

PART 2   PRODUCTS

2.01 RECORD DRAWINGS

A. Maintain one set of black-line prints of the Contract Drawings. Mark-up drawings using erasable red-colored pencil. Use additional colors as necessary to clearly document changes from original drawings for different categories of work at the same location.

B. Use clear original or copy of project drawings for mark-up. Use shop drawings for markup when they are more capable of showing actual physical conditions completely and accurately.

C. All deviations or differences from the original drawings, including dimensional, location, layout, material, and other details shall be noted clearly. Any additional information discovered during construction shall also be noted including location and depth of buried utilities and structures not shown in the original drawings.
2.02 FORMAT
   A. Organize Record Drawings into manageable sets using plans and shop drawings as applicable. Keep sets bound and protected.
   B. Keep on-site during construction and clearly identify as “Record Drawing” on cover.

PART 3 EXECUTION

3.01 RECORDING AND MAINTENANCE
   A. Record data as soon as possible after obtaining it. Do not wait until the end of the job or a portion of the job to record data.
   B. Give particular attention to information concealed that would be difficult to identify or measure and record later. Record and check the markup before enclosing concealed installations.
   C. Require the individual who installed or constructed the portion of the work, or otherwise obtained the record data, to prepare that portion of the marked-up record print.
   D. Incorporate changes and additional information previously marked on Record Drawings, erase, redraw, and add details and notations where applicable.
   E. Refer instances of uncertainty to Engineer for resolution.

END OF SECTION
SECTION 01800 – FACILITY COMMISSIONING AND TRAINING

PART 1   GENERAL

1.01  SUMMARY

A. This section includes procedures, requirements, and specifications for the commissioning and startup of all new equipment and facilities provided on the project.

B. The general contractor shall be responsible for arranging for and administering testing, training, commissioning, and startup for all new facilities.

C. All mechanical, electrical and instrumentation equipment shall be inspected and tested to prove compliance with the Contract Documents and with the manufacturer's installation and construction requirements. All costs of testing, including temporary facilities, shall be borne by the Contractor.

D. For the purposes of this Section, equipment shall mean any mechanical, electrical, instrumentation, or other device or system supplied as part of the project.

1.02  TESTING/COMMISSIONING

A. All equipment shall be tested by the Contractor to the satisfaction of the Engineer before any facility is put into operation. Test shall be as specified herein and per individual sections through this document. Dry tests shall be run to determine whether the equipment has been properly assembled, aligned, adjusted, balanced, calibrated, and otherwise set up properly.

B. Any repairs, modifications, adjustments, or reconfigurations required to make the equipment operate as specified shall be carried out by the Contractor and all costs associated with this work borne by the Contractor alone.

C. Test procedures shall be designed to duplicate, as nearly as possible, all typical conditions of operations. Coordinate all testing procedures and requirements with the individual equipment manufacturers and suppliers. Testing should also be coordinated with the engineer.

D. Upon completion of dry testing, acceptance testing of the equipment shall be completed. Acceptance testing shall be defined as testing the equipment under simulated operation and shall include, at a minimum:

1. Wet well water-tightness.
2. Pump operation.
3. Float operation.
4. Controls and alarm operation.
5. Flow meter recording.

E. All equipment manufacturers or their authorized representatives, at the end of the testing and commissioning process, shall “sign off” on an acceptance form that their equipment
has been installed properly and the commissioning process was successful in testing and starting up each piece of equipment of the system.

1.03 TRAINING

A. Training of the Owner’s personnel shall be done by experienced technical representatives from each manufacturer for each major piece of equipment or system on the project.

B. At a minimum, the training representative shall review the following with the Owner’s personnel:

1. Catalog cut sheets, parts lists, drawings, and other details provided by the manufacturer in the O&M Manuals.

2. Demonstrate all features of the new equipment including controls, adjustments, and configurations.

3. Point out safety references, procedures, and warnings.

4. Discuss precautionary measures that should be taken around the equipment.

5. Explain all standard modes of operation including automatic, hand, overrides, and others.

6. Review preventative maintenance requirements and regular maintenance procedures, wear items, spare parts requirements, and other steps that should be taken to ensure long service life for the equipment.

7. Discuss troubleshooting issues, commonly asked questions, common problems or pitfalls to avoid, and other helpful operational information.

8. Review procedures for service or support calls. Review who will provide maintenance or warranty support, where they will come from, and likely lead times for support.

9. Answer any questions that are raised by the operations staff and engineer.

C. The Contractor shall coordinate training with the Engineer and the manufacturer’s representatives. Training schedules shall be such that only one manufacturer’s representative is on site at any one time to provide training.

1.04 MEASUREMENT AND PAYMENT

A. Payment for this item shall be included within the per unit price for each item of construction requiring “start-up”, commissioning and/or training. No separate payment will be made for this item.

END OF SECTION
## DIVISION 2 - SITE WORK
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SECTION 02240 – CONTROL OF WATER

PART 1   GENERAL

1.01 WORK INCLUDED

A. This section covers the control of surface water runoff, dewatering of pipeline trenches and structural excavations, bypass pumping of sanitary sewer systems, and other elements required for control of water.

B. The design, installation, and operation of the temporary pumping system shall be the Contractor’s responsibility. The Contractor assumes all liability for operation of the bypass system and shall man the system during its operation. The by-pass system shall meet the requirements of all codes and regulatory agencies having jurisdiction of the system operation.

C. Submittals

1. Prior to performing any excavation, the Contractor shall submit a dewatering plan to the Engineer for review. The submittal shall include method of installation and details of the proposed dewatering system.

PART 2   PRODUCTS

2.01 MATERIALS

A. Materials and equipment required for control of water shall be furnished and maintained as required to perform the construction.

B. Pumps

1. Bypass pumps, if required, shall be fully automatic, solids handling, self-priming units.

2. Contractor shall supply all necessary stop/start controls for each pump.

3. Backup pumps shall be available in the case of a primary pump failure.

C. Piping/Hose

1. Contractor shall provide temporary discharge piping constructed of rigid pipe with positive restrained joints.

2. No aluminum irrigation type piping to be allowed.

3. Discharge hose may be allowed for short sections with prior Engineers review and approval.

4. Provide watertight pipe system.
PART 3  EXECUTION

3.01  WORKMANSHIP

A.  The necessary machinery, appliances and equipment shall be provided and operated to keep excavations free from water during construction, and to dispose of the water so as not to cause injury to public or private property or to cause a nuisance or a menace to the public.  Sufficient pumping equipment and machinery in good working condition shall be provided for all emergencies including power outage, and sufficient workmen shall be available at all times for the operation of the pumping equipment.  The dewatering systems shall not be shut down between shifts, on holidays or weekends, or during work stoppages without written permission from the Engineer.

B.  The control of groundwater if present shall be such that softening of the bottom of excavations, or formation of “quick” conditions or “boils” during excavation, shall be prevented.  Dewatering systems shall be designed and operated so as to prevent removal of the natural soils.  Natural or compacted soils softened by saturation with groundwater or standing surface water shall be removed and replaced as instructed by the Engineer at no additional expense to the Owner.

C.  During construction of structures, installation of pipelines, placing of structure and trench backfill and the placing and setting of concrete, excavations shall be kept free of water.  Surface runoff shall be controlled so as to prevent entry or collection of water in excavations.  The static water level shall be drawn a minimum of one (1) foot below the bottom of the excavation, so as to maintain the undisturbed state of the foundation soils and allow the placement of fill or backfill to the required density.  The dewatering system shall be installed and operated so that the groundwater level outside the excavation is not reduced to the extent that would damage or endanger adjacent structures or property.

D.  Open and cased sumps shall not be used as primary dewatering for excavations deeper than three (3) feet below the static water table.  Location of open or cased sumps shall be outside of trench excavation or limits of structural excavation.

E.  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 and pipelines.

F.  Provisions shall be made to take care of surplus water, mud, silt or other runoff pumped from excavations and trenches or resulting from slicking or other operations.  Siltation of completed or partially completed structures and pipelines by surface water or by disposal of water from dewatering operations shall be cleaned up at the Contractor's expense.

G.  Comply with all laws regarding stormwater runoff, protection of natural resources, and other applicable laws and regulations.  A small settling pond, tank or filtering device shall be used to remove sediment from surplus water and the water then removed into a sewer manhole.  Engineer shall approve settling pond or device prior to pumping water into sewer system.

H.  The Contractor shall be responsible for any damages to existing on- and off-site facilities and work in-place resulting from mechanical or electrical failure of the dewatering system.

I.  The Contractor shall comply with all applicable local, State, and Federal laws and regulations pertaining to erosion control and discharge of water off-site.

J.  Necessary filtering media, bags, or other methods shall be used to ensure that turbidity limits in the receiving bodies are not exceeded during dewatering activities.
K. Sanitary Sewer Bypass Pumping. Pump shall be suitably sized to handle all incoming flows. Bypass pumping shall be provided continuously until normal flow patterns in sanitary sewers can be reestablished.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for all Control of Water and other work in this section shall be included within the lump sum basis for the amount stated on the Bid Form for Bypass Pumping.

B. Payment for all Control of Water and other work in this section shall be included within the lump sum basis for the amount stated on the Bid Form for Dewatering.

END OF SECTION
SECTION 02250 – DEMOLITION AND SITE PREPARATION

PART 1  GENERAL

1.01  SUMMARY

A. The work in this section includes the furnishing of all labor, equipment, materials, incidentals, and performing all work required for the removal and disposal of concrete, miscellaneous structures, sewer piping as designated for removal, debris and other items or improvements of manmade origin, in accordance with the Plans and these Specifications. This includes the decommission and slurry filling of the existing Jeans Road Lift Station.

B. The removal work described herein does not include the removal or disposal of items or improvements designated to remain.

C. The area in which removal work, under these Specifications, is to be performed shall be confined to the minimum dimensions, within the public right-of-way or easements, which will permit proper construction of the proposed improvements, or as otherwise indicated.

PART 2  PRODUCTS

2.01  MATERIALS

A. Landscape Restoration shall be as specified in Section 02900.

B. Trench Excavation and Backfill shall comply with Section 02315

C. Asphalt concrete pavement shall comply with Section 02740

D. Landscape restoration shall comply with Section 02900

E. Concrete shall be as specified in Section 03300

F. Structural Backfill shall comply with Section 02316

PART 3  EXECUTION

3.01  WORKMANSHIP

A. Pavements, Curbs, Walks and Driveways

1. Where construction operations require the removal of pavements and other concrete flatwork or structures, bituminous pavements or portions thereof, the area to be removed shall be neatly sawcut. Just prior to placement of hot ac pavement final sawcuts shall be made 6-inches outside the limits of the trench on each side to a depth of 1½-inches, or deeper as required, to permit the removal of material without damage to adjoining portions of structures to be left in place. All cuts shall be clean, vertical cuts made true to lines designated or approved by the Engineer. See Detail drawings for further clarification.
The Contractor shall remove and dispose of all pavement and structures, or portions thereof, which lie within the limits of excavation.

2. Pavements and/or structures designated to remain but damaged as a result of the Contractor’s operations shall be sawcut and removed as described above, and replaced or restored at the sole expense of the Contractor.

3. Concrete shall be deposited in forms without segregation and tamped spaded or mechanically vibrated for thorough consolidation.
   
a. Finishing shall produce a smooth finish matching surrounding finish or a non-slip broom finish as applicable unless otherwise specified in Section 3300.

b. Sidewalks shall be 4-inches thick and shall match existing sidewalks at limits of replacement.

c. Driveway approaches shall be 6-inches thick and shall match existing sidewalks at limits of placement.

4. Provide expansion joints around poles, fire hydrants, limits of driveways and other fixtures that protrude through or against the structures and at points of curvature. Scored joints shall be required at 5-foot centers.

5. Curing, protection and concrete testing shall comply with applicable Sections of Division 03000.

B. Removal and Disposal of Asbestos-Containing Pipe

1. Removal of Asbestos-Containing Pipe
   
a. When existing pipe containing asbestos (i.e. Transite or A.C. Pipe) is exposed, cut or removed, all requirements of the EPA, Oregon DEQ, and OR-OSHA shall be followed. Specific guidelines pertaining to the handling and removal of asbestos-containing materials are given in OAR 340, Division 248 and OAR 437, Division 3, Construction. The Contractor is required to be familiar with these and all other requirements related to the removal, handling and disposal of asbestos-containing material, and shall comply with all such laws and regulations.

b. All asbestos-containing pipe that is not removed or otherwise disturbed shall be left or abandoned in place. The location of all such pipe shall be documented by the Contractor on the As-Built plans.

2. Disposal of Asbestos-Containing Pipe
   
c. All asbestos-containing pipe that is removed from the ground or otherwise disturbed must be handled, enclosed, encapsulated, and removed in accordance with the provisions of 29 CFR 1926.1101 in OAR 437, Division 3, Construction.

   d. The asbestos-containing pipe must be adequately wetted to prevent the release of asbestos fibers during cutting and handling. Asbestos-containing materials must be disposed of in leak-tight 6-mil thick plastic bags, plastic-lined cardboard containers or plastic lined metal containers, in accordance with the above requirements.
e. The sealed containers of asbestos-containing pipe shall be hauled to an approved asbestos landfill and disposed of according to DEQ regulations and the landfill requirements.

f. The Contractor shall take special precautions to protect the integrity of the asbestos-containing pipe and prevent the release of asbestos during the handling, loading and transportation of the pipe.

C. Valves and valve covers, fittings, and other pipe appurtenances designated for removal shall be removed in their entirety to the limits shown on the Plans, or as required to permit proper construction of the proposed improvements. Remaining ends of pipes shall be suitably capped or plugged in a watertight manner. Provide a minimum of two (2) feet of concrete slurry filling inside of pipe for full diameter unless otherwise specified on plans.

D. Salvaged Materials

1. Materials to be salvaged and returned to the City include: All Scada controls and components, pumps, and miscellaneous items in the utility cabinet shall remain the property of the City and shall be salvaged as directed by the City Engineer and delivered to the City’s storage yard by Contractor.

2. Other salvageable materials shall become the property of the Contractor and shall be disposed of by the Contractor away from the site.
   a. Salvaged materials of any kind shall not be reused in new work without the written approval of the Engineer.

E. Abandonment of Existing Structures

1. Structures to be abandoned in place shall be removed to a depth indicated on the Plans. Exposed pipes shall be plugged with concrete and the remainder of the structure filled with 3/4-inch or 1-minus crushed aggregate.

2. Wetwell shall be cleaned of all sewage, grit and sludge prior to abandonment.

3. Interior surfaces of the ends of pipes to be abandoned shall be cleaned prior to constructing permanent plugs. Concrete plugs shall be constructed in the ends of all pipe 18-inches in diameter or less. Concrete pipe shall be at least 8-inches thick.

F. All items and materials designated to remain shall be protected against damage as required. Damage to items or materials not intended for removal shall be repaired promptly by the Contractor to the satisfaction of the affected property owner. If the Engineer determines it necessary, repairs shall consist of complete replacement of the affected items or materials. All such repairs and replacements shall be made by the Contractor without compensation.

G. Disposal of Materials

1. All materials, except those determined by the Engineer or Owner to be reusable, shall become property of the Contractor at the place of origin and shall be disposed of by the Contractor in conformance with all laws, regulations and rules legally imposed on such activities.
a. Contractor shall make every effort to salvage or recycle construction demolition items and debris as is feasible.

2. Materials shall not be disposed of on City owned or City controlled lands except by written permission of the City, and if so permitted, the materials shall be placed only at such locations and in such manner as the City may direct. Materials may be disposed of on private properties only with written permission of the property owner(s) involved, and with copies of the agreement furnished to the City and Engineer.

H. Excavations resulting from the removal of structures and/or obstructions shall be backfilled and compacted in accordance with the requirements of Section 02315. Backfill materials shall consist of the type and class designated on the Plans and specified in Section 02315.

G. All existing ditches damaged by the Contractor by his operations and incidental ditching shall be re-constructed as required as to maintain existing drainages and ditches. The Contractor shall maintain channel width and side slopes of existing conditions.

1. Existing sanitary sewer pipe and laterals where designated shall be removed entirely to the limits shown on the Plans or to the limits as required to facilitate proper installation and connection of new facilities.

2. Existing sanitary sewer manholes where designated for removal shall be removed to the limits shown or described on the Plans & Specifications or to the limits as required to facilitate the proper abandonment of existing facilities and installation and placement of new facilities.

3. Abandon Piping
   a. Exposed ends of remaining mainline or lateral shall be suitably capped or plugged in a watertight manner and pack end with a concrete slurry to seal completely.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Demolition & Site Preparation shall be made on a lump portions basis for the amount stated on the Bid Form. Payment shall include compensation for all work described herein for the removal, abandonment and disposal of portions of sewer pipe, structures and obstructions as required for the proposed improvements. Contractor shall sequence his work in such a way that no disruption of the existing service or system occurs unless said disruption is approved by the Engineer.

B. Measurement and payment for abandonment of those portions of the existing mainline and laterals, including end caps, shall be included within the lump sum cost of Demolition & Site Preparation. A separate payment will not be made for this item.

C. Measurement and payment for the removal and disposal of excavated material for the removal and abandonment of existing manhole and appurtenances and backfill shall be included within the lump sum cost of Demolition & Site Preparation as stated on the Bid Form. A separate payment will not be made for this item.
D. Measurement and payment for ac pavement excavation and disposal, backfill and other preparation of trenches shall be included in the lineal foot cost for gravity and pressure sewer pipe.

E. The Cost for sawcutting existing pavement adjacent to new utility trenches shall be considered incidental to the work. No additional compensation will be allowed for sawcutting.

F. Measurement and payment for ac pavement replacement shall be as specified in Section 02740.

G. No additional compensation will be allowed the Contractor for the handling, removal or disposal of any asbestos-containing pipe encountered during construction.

END OF SECTION
SECTION 02260 - SHORING AND BRACING

PART 1 GENERAL

1.01 SUMMARY

A. This section specifies requirements for shoring and bracing of trenches and other excavations as required to furnish safe and acceptable working conditions, protect existing and new structures and vegetation and maintain existing slopes, fills and open excavations.

B. The Contractor shall have sole responsibility to determine the construction means and methods required to satisfy the requirements of this section. The Contractor shall design sheeting, shoring and bracing in accordance with Oregon Occupational Safety and Health Act (OSHA).

C. The Contractor shall furnish a safe place of work pursuant to the provisions of OSHA and the subsequent amendments and regulations and for the protection of the work, structures and other improvements.

D. Shoring and bracing shall include all necessary sheeting, sloping and other means and procedures such as draining and recharging groundwater and routing and disposing of surface runoff, required to maintain the stability of soils.

E. Slope Stability

1. OSHA Health and Safety Standards for Excavation, 29 CFR Part 1926, or successor regulations shall be strictly enforced and, if they are not followed, the Contractor and/or earthwork and utility subcontractor could be liable for penalties.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 WORKMANSHIP

A. General

1. The construction of sheeting, shoring and bracing shall not disturb the state of soil adjacent to the excavation or below the excavation bottom. Sheet ing, shoring and bracing shall be removed after placement and compaction of initial backfill, except as otherwise specified.

B. Structure and Existing Piping

1. The Contractor shall provide support of existing and new structures where shown, specified and at all other locations where excavation infringes on a 1:1 slope extending from the bottom of the footing. Existing piping shall be protected with shoring and bracing where excavation could expose the pipe and/or cause damage to the pipe.
C. Damages

1. Any damages to new or existing structures occurring through settlements, water or earth pressures, or other causes due to failure or lack of sheeting, shoring or bracing, or through negligence or fault of the Contractor shall be repaired by the Contractor at his own expense.

PART 4 SPECIAL PROVISIONS

4.01 Measurement and Payment

A. Payment for all shoring, bracing and other work in this section shall be included within the lump sum basis for the amount stated on the Bid Form.

END OF SECTION
SECTION 02315 – TRENCH EXCAVATION, BEDDING AND BACKFILL

PART 1 GENERAL

1.01 SUMMARY

A. This work consists of furnishing all labor, materials, incidentals and equipment, as well as performing all work required for excavation, foundation stabilization, pipe bedding, pipe zone material, trench backfill, compaction, final grading, hauling and disposal of material resulting from the construction of sewer piping, manholes, and all related appurtenances. Included also is the locating and protecting of existing utilities and other improvements (see Division 1), shoring, bracing, and dewatering of excavations, excepting only such work as is covered and included under other sections of this Division, or other Divisions of these Contract Documents.

B. Excavation must be in accordance with ORS 757.541 to 757.571 and all other applicable laws and regulations.

1.02 REFERENCES


1.03 DEFINITIONS

A. Trench Excavation – Trench excavation consists of the removal of all material encountered in the trench to the limits shown on the Plans or as directed. Trench excavation shall be classified as either common excavation or rock excavation.

1. Common excavation is defined as the removal of all material as required to complete the planned improvements, regardless of type, nature or condition of materials encountered, except that which is designated as rock excavation.

2. Rock excavation is defined as the removal of boulders composed of igneous, sedimentary or metamorphic stone material which have a least dimension of 36-inches or more, or a displacement of one cubic yard or more; or the removal of solid ledge rock which, in the opinion of the Engineer, requires for its removal drilling and blasting, wedging, sledging, barring or breaking with power operated tools.

a. No soft or disintegrated rock; hard-pan or cemented gravel that can be removed with a hand pick or power operated excavator or shovel; no loose, shaken, or previously blasted rock or broken stone in rock fillings or elsewhere; and no rock outside of the minimum limits of measurement allowed, which may fall into the excavation, will be measured or allowed.

b. When solid rock layers have an overburden of non-rock material (common material) which cannot practically be stripped and handled separately, and/or when solid rock is interspersed with non-rock material, the entire mass will be classified as solid rock if the actual solid rock fraction exceeds 85% of the entire volume.

B. Trench Foundation – Trench foundation is defined as the bottom of the trench on which the pipe bedding is to lay and which provides support for the pipe.
C. Foundation Stabilization – Foundation stabilization is defined as the furnishing, placing and compacting of specified materials for any unsuitable material removed from the bottom of an excavation, as directed by the Engineer, to provide a firm trench foundation.

D. Pipe Bedding – Pipe bedding is defined as the furnishing, placing and compacting of specified materials on the trench foundation so as to uniformly support the barrel of the pipe. The total bedding depth shall be a minimum of 6-inches below the outside bell of the pipe.

E. Pipe Zone – Pipe zone is defined as the furnishing, placing and compacting of specified materials for the full width of the trench and extending from the top of the bedding to a level 10-inches above the top outside surface of the barrel of the pipe. Specified zone material to be placed in this region in conformance with these Specifications.

F. Trench Backfill – Trench backfill is defined as the furnishing, placing and compacting of material in the trench extending from the top of the pipe zone to the bottom of pavement base, ground surface or surface material. Plans generally show locations for each type of backfill class.

G. Drain Rock – Drain rock is defined as the furnishing, placing and compacting of specified free draining material for the full width of the drain trench (perforated pipe drains) and extending to a level as specified above the top outside surface of the pipe barrel.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

A. Trench Foundation – The trench foundation shall be undisturbed native material when suitable. Where ground water or other unstable conditions exist and the native material cannot properly support the pipe, additional excavation may be required. The trench shall be stabilized with foundation stabilization material when such conditions are present in the opinion of the Engineer.

B. Foundation Stabilization – Foundation Stabilization: 1½"-0 or 2"-0 aggregate base rock meeting OSS Sections 00641 and 02630. Required when native trench foundation material contains groundwater, or is unsuitable to provide a firm foundation in the opinion of the Engineer.

C. Pipe Bedding – Material for pipe bedding shall be clean, hard, sound, durable, well-graded, ¾-inch minus pea gravel or crushed rock, free from organic matter. Engineer must approve material prior to use.

D. Trench Backfill

1. Class "A" Backfill: Native or common excavated material, free from organic or other deleterious material, free from rock larger than 3-inches, and which meets the characteristics required for the specific surface loading or other criteria of the backfill zone in the opinion of the Engineer. If stockpiled material becomes saturated or unsuitable, Class B, C or D Backfill shall be substituted. Engineer must approve material prior to use.

2. Class "B" Backfill: ¾"-0 dense-graded aggregate, uniformly graded from coarse to fine and meeting OSS Section 02630.10.

3. Class "C" Backfill: Clean sand with no particles larger than ¼-inch.
4. Class “D” Backfill: Pit run or bar run material, well graded from coarse to fine, with maximum aggregate size of 3 inches.

5. Class “E” Backfill (CLSM or CDF): Controlled Low-Strength Material (cement slurry) conforming to OSS Section 00442.
   a. Slurry shall consist of a highly flowable lean concrete mix; mixture of Portland cement, fly ash, fine aggregates, water and admixtures as required for a mixture that results in a hardened, dense, non-settling, hand excavatable fill.

PART 3 EXECUTION

3.01 GENERAL

A. Remove, haul, and dispose of all formations and materials, natural or man-made, irrespective of nature or conditions encountered, within lines and grades shown on the Plans or defined herein, and as necessary for completion of the proposed improvements. The method of excavation shall be as determined by the Contractor, and as required for special protection of existing improvements. Special care shall be taken to avoid over-excavation below subgrades. Store and protect materials suitable for use as backfill where applicable. Clearing and Grubbing and Removal of Structures and Obstructions to be completed prior to excavation.

B. When the precise location of subsurface structures and/or utilities is unknown, locate such items by hand excavation prior to utilizing mechanical excavation equipment. Use hand excavation when mechanical equipment might damage existing improvements which are to remain undisturbed. See Division 1 for other requirements.

C. Incidental to excavation shall be the furnishing, installing and removal of all shoring, sheeting, bracing and dewatering equipment as required to support adjacent earth banks and structures, keep excavations free from excess water, and to provide for the safety of the public and all personnel working in excavations.

3.02 EXCAVATION

A. Excavate to the lines and grades shown on the project Plans, allowing for forms, shoring, working space and gravel base. Provide minimum 6-inch clearance around pipe barrel in all directions or greater in accordance with the standard trench detail drawing.

B. Shoring and Bracing
   1. Sheet and brace excavation as necessary to prevent caving and to protect adjacent structures, property, workers and the public.
   2. All sheeting, shoring and bracing shall conform to safety requirements of OSHA and other Federal, State and local agencies.

C. Dewatering
   1. Furnish, install and operate all necessary machinery, appliances and equipment to keep excavations free from water during digging and initial backfilling. Dispose of water in such a manner as to prevent damage to public or private property, or nuisance or menace to the public.
2. At all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outage. Have available, at all times, competent workers for operation of the equipment.

3. Control surface runoff to prevent entry or collection of water within excavations. All excavations shall be kept free of water during placement of backfill and/or concrete placement.

4. Comply with all laws regarding stormwater runoff, protection of natural resources, and other applicable laws and regulations.

3.03 FOUNDATION STABILIZATION

A. The contractor shall over-excavate the trench to firm undisturbed soils or rock when, in the opinion of the Engineer, the trench foundation materials are not suitable for the support of the pipe. Foundation Stabilization materials, as specified, shall be placed and compacted in lifts not exceeding 6-inches in compacted thickness to the required grade. Each lift shall be compacted to at least 95% relative compaction in accordance with ASTM D698.

3.04 DISPOSAL OF EXCESS MATERIALS

A. Excavated materials not suitable or required for backfill shall be hauled away and disposed of on approved sites arranged by the Contractor. No site shall be used for disposal of materials without written approval of the property owner. All costs associated with the hauling and disposal of materials shall be borne by the Contractor. The Contractor shall be entitled to any proceeds received from the sale of excess materials.

3.05 TEMPORARY STOCKPILING

A. Place excavated materials suitable for use as backfill (and not excess material) only within construction easements, right-of-way, or approved work area. Stockpiles shall be placed in such manner as to provide the minimum inconvenience to the public.

B. The Contractor shall obtain written permission from any property owners prior to placement of stockpiles on private property. Provide copies to the Owner and Engineer. Remove stockpiles as soon as possible and restore sites to affected property owners’ satisfaction.

C. Access to all fire hydrants, water valves and meters shall be maintained. Stockpiles shall not be permitted to block any stormwater drainage ditches, gutters, drain inlets, culverts or natural water courses.

D. Protect stockpiled material which is to be later incorporated into the work so that excessive wetting or drying of the material does not occur. Material shall be brought to near optimum moisture content prior to placement and compaction. Depending on the moisture content of stockpiled materials, necessary processing may include aeration, mixing and/or wetting. No additional payment will be allowed for protecting or preparing native backfill materials.

E. If approved native materials become unsuitable (too wet or mixed with unsuitable materials) due to negligence by the Contractor, then imported granular materials may be required for backfilling at the subject location at no additional cost to the Owner.
F. Provide necessary protection for stockpiled materials so that silt-laden runoff does not occur during rain events and to prevent wind-blown dust from stockpiles.

3.06 TRENCH BACKFILL

A. Place and compact pipe bedding material before placing pipe in the trench. Dig depression for pipe bells to provide uniform bearing along the entire pipe length. Thoroughly compact bedding material.

B. Place materials in the pipe zone in layers not greater than 6 inches thick and in a manner that equalizes the pressure on the pipe and minimizes stress. As required under the haunches of pipe and areas not accessible to mechanical tampers or to testing, compact with hand methods to ensure thorough contact between the material and the pipe. Before placing the pipe zone material, condition, aerate, or wet the material so that the moisture content of each layer is within minus 4% to plus 2% of optimum moisture content.

C. Contractor shall backfill the trench above the pipe zone in successive lifts not exceeding 12-inches in loose thickness. Do not allow the backfill to free-fall into the trench until at least 3 feet of cover is provided over the top of the pipe. Each lift shall be compacted, using suitable mechanical or pneumatic equipment, to a minimum of 95% of the maximum dry density as determined by ASTM D698. If the specified compaction is not obtained, the Contractor may be required to use a modified compaction procedure and/or reduce the thickness of lifts. If approved materials meeting the specifications cannot be compacted to the required density regardless of compactive effort or method, the Engineer may reduce the required density or direct that alternate materials be used. In no case shall excavation and pipe laying operations proceed until the Contractor is able to compact the backfill to the satisfaction of the Engineer.

D. CLSM. When CLSM Backfill is required, backfill above pipe zone with CLSM material. If the CLSM is to be used as a temporary surfacing, backfill to top of the trench and strike off to provide a smooth surface. If CLSM is not to be used as a temporary surface, backfill to bottom of the proposed resurfacing. Use steel plates to protect the CLSM from traffic a minimum of 24 hours.

E. When backfilling is complete, the Contractor shall finish the surface area as specified. In paved or graveled areas the Contractor shall maintain the surface of the trench backfill level with existing adjacent grades with ¾"-0 crushed rock until pavement replacement is completed and accepted by Owner.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Trench Excavation, Shoring, hauling excavated material, Bedding, Pipe Zone, and Backfill shall be included within the unit prices for piping, other structures, service laterals and all associated appurtenance items. Price will include all such work and materials required for each backfill class and size and type of pipe as shown in the Bid Form. A separate payment will not be made for these items.

B. Payment for Trench Excavation, Bedding and Backfill shall be included within the unit prices for sewer lines and associated appurtenance items. Price will include all such trench work and materials required for each backfill class and size and type of pipe as shown in the Bid Form. A separate payment will not be made for this item.
C. Payment for Foundation Stabilization will be made on a cubic yard basis, truck measure. Payment shall include all excavation, removal and disposal of existing materials excavated and placement of new foundation material.

D. Payment for Gravel Access Road will be made on a cubic yard basis, truck measure. Payment shall include all excavation, removal and disposal of existing materials excavated and placement of new material.

E. Payment for Rock Excavation (when applicable) will be made on a cubic yard basis as stated in the Bid Form. Measurement for rock excavation will be based on the trench width, depth and length for the area where rock is encountered within the pay limits defined on the Drawings, and must be approved by Engineer. When Bid Form contains no item for Rock Excavation, rock excavation is not anticipated.

END OF SECTION
SECTION 02316 – EXCAVATION AND SELECT (STRUCTURAL) BACKFILL

PART 1 GENERAL

1.01 SUMMARY

A. This work consists of furnishing all labor, materials, incidentals and equipment, as well as performing all work required for excavation and structural fill placement for the lift station.

B. Excavation must be in accordance with ORS 757.541 to 757.571 and all other applicable laws and regulations.


1.02 REFERENCES


1.03 DEFINITIONS

C. Excavation – excavation consists of the removal of all material at site to the limits shown on the Plans or as directed. Excavation shall be classified as either common excavation or rock excavation as specified in Section 02315.

D. Foundation – foundation is defined as the bottom of the excavated area on which the granular pad is to lay and which provides support for the pipe and granular pad.

E. Foundation Stabilization – Foundation stabilization is defined as the furnishing, placing and compacting of specified materials for any unsuitable material removed from the bottom of an excavation, as directed by the Engineer, to provide a firm foundation.

F. Select Fill – Select fill is defined as furnishing, placing and compaction of specified material for the entire excavated area for granular pad.

PART 2 PRODUCTS

2.01 MATERIALS

A. Granular Pad Foundation – The trench / granular pad foundation shall be undisturbed native material when suitable. Where ground water or other unstable conditions exist and the native material cannot properly support the pipe or granular pad, additional excavation may be required. The excavation shall be stabilized with foundation stabilization material when such conditions are present in the opinion of the Engineer.

B. Foundation Stabilization – Foundation Stabilization: ¾”-0 well-graded aggregate base rock meeting 2008 OSS Sections 00641 and 02630. Required when native excavation foundation material contains groundwater, or is unsuitable to provide a firm foundation in the opinion of the Engineer.
C. Select Fill - select fill shall consist of ¾”-0, well-graded, crushed aggregate base rock meeting 2008 OSS Section 02630.10. Engineer must approve material prior to use.

D. Contractor shall adhere to the Geotechnical Engineering Report for recommendations on fill materials and associated depths.

PART 3  EXECUTION

3.01  GENERAL

A. Remove, haul, and dispose of all formations and materials, natural or man-made, irrespective of nature or conditions encountered, within lines and grades shown on the Plans or defined herein, and as necessary for completion of the proposed improvements. The method of excavation shall be as determined by the Contractor, and as required for special protection of existing improvements. Special care shall be taken to avoid overexcavation below subgrades. Store and protect materials suitable for use as backfill where applicable. Clearing and Grubbing and Removal of Structures and Obstructions to be completed prior to excavation.

B. When the precise location of subsurface structures and/or utilities is unknown, locate such items by hand excavation prior to utilizing mechanical excavation equipment. Use hand excavation when mechanical equipment might damage existing improvements which are to remain undisturbed. See Division 1 for other requirements.

D. Subgrade shall be inspected by a licensed geotechnical engineer hired by the Project Engineering prior to compaction or placement of select fill.

1. Inspections shall be required at:
   a. Prior to placement of wetwell base.
   b. Prior to beginning site grade fill
   c. During grade fill compaction.

C. Shoring and Bracing

1. Sheet and brace excavation as necessary to prevent caving and to protect adjacent structures, property, workers and the public.

2. All sheeting, shoring and bracing shall conform to safety requirements of OSHA and other Federal, State and local agencies.

D. Dewatering

1. Furnish, install and operate all necessary machinery, appliances and equipment to keep excavations free from water during digging and initial backfilling. Dispose of water in such a manner as to prevent damage to public or private property, or nuisance or menace to the public.

2. At all times have on hand sufficient pumping equipment and machinery in good working condition for all ordinary emergencies, including power outage. Have available, at all times, competent workers for operation of the equipment.

3. Control surface runoff to prevent entry or collection of water within excavations. All excavations shall be kept free of water during placement of backfill and/or concrete placement.
4. Comply with all laws regarding stormwater runoff, protection of natural resources, and other applicable laws and regulations.

5. A small settling pond, tank or filter shall be used to remove sediment from water and the water then removed into a sewer manhole. Engineer shall approve settling device prior to pumping water into sewer system.

6. Dewatering recommendations are provided in the most recent Geotechnical Investigation Report prepared by Carlson Geotechnical for this project. Contractor shall conform to recommendations in the report.

3.02 EXCAVATION

A. Excavate to the lines and grades shown on the project Plans, allowing for forms, shoring, working space and gravel base.

3.03 FOUNDATION STABILIZATION / OVER EXCAVATION

A. Foundation stabilization shall be placed and compacted in accordance with the recommendations of the Geotechnical Report.

B. The contractor shall over excavate the pipeline trench to firm undisturbed soils or rock when, in the opinion of the Engineer, the trench foundation materials are not suitable for the support of the pipe. Foundation stabilization materials, as specified, shall be placed and compacted in lifts not exceeding 6-inches in compacted thickness to the required grade. Each lift shall be compacted to at least 95% relative compaction in accordance with ASTM D698.

3.04 DISPOSAL OF EXCESS MATERIALS

A. Excavated materials not suitable or required for backfill shall be hauled away and disposed of on approved sites arranged by the Contractor. No site shall be used for disposal of materials without written approval of the property owner. All costs associated with the hauling and disposal of materials shall be born by the Contractor. The Contractor shall be entitled to any proceeds received from the sale of excess materials.

3.05 INSPECTION

A. Contractor shall notify Engineer not less than 48 hours prior to required inspections. Required geotechnical inspections shall not be waived and work shall not proceed until inspection has been completed and the Contractor has been authorized to proceed by the Engineer.

a. Geotechnical Engineer shall inspect excavated subgrade under the wetwell prior to subgrade compaction or placement of select fill. Engineer may require adjustment to the subgrade, compaction of the subgrade, or other action depending on actual conditions.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Excavation and placement of Backfill and Select Fill shall be included within the unit price basis for the amount stated on the Bid Form for the sewer pipe.

END OF SECTION
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SECTION 02320 – BYPASS PUMPING

PART 1  GENERAL

1.01  SUMMARY

A. The work in this section includes the furnishing of all labor, equipment, materials, incidentals, and performing all work required to implement a temporary bypass pumping system for the purpose of diverting sanitary sewer flows around the designated work zone for the project duration.

B. The operation, design and installation of the temporary bypass pumping system shall be the responsibility of the Contractor. The Contractor assumes all liability for the operation of the bypass pumping system and shall man the system during its operation. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction of the systems operation.

C. Submittals

1. Prior to the start of any excavation the Contractor shall submit a bypass pumping plan to the Engineer for review. The submittal shall include the method of installation and details of the proposed bypass pumping system.

PART 2  PRODUCTS

2.01  MATERIALS

A. Materials and equipment required for the bypass pumping equipment shall be furnished and maintained as required to perform the sanitary sewer line replacement.

B. Pumps

1. Bypass pumps shall be fully automatic, solids handling, self priming units.

2. Contractor shall supply all necessary start/stop controls for each pump.

3. Backup pumps shall be available in the case of a primary pump failure.

C. Piping/Hose

1. Contractor shall provide temporary bypass discharge piping constructed of pipe with positive restrained joints.

2. Use of discharge hose may be allowed for short sections with Engineers review and prior approval.

3. Discharge piping system shall be watertight. Contractor shall perform pressure and leakage tests on the bypass pumping system prior to start of operation of the system.

PART 3  EXECUTION

3.01  WORKMANSHIP
A. It is essential to the operation of the existing sanitary sewer system that there will be no interruption in the flow of sewerage during the duration of the project. Operation of the bypass pumping system shall maintain the sanitary sewer flows around the work area in such a manor as not to cause surcharging of upstream and downstream sewers, damage to existing sewers, and will protect both public and private property from flooding and damage.

B. Contractor shall provide, maintain and operate all temporary facilities such as dams, plugs, primary pumping equipment, back up pumping equipment, bypass piping and all necessary power, labor and equipment as required to intercept the sewage flow prior to interfering with the work area. Flows shall be conveyed past the work area and returned to the existing sewer system at a point downstream of the work area.

1. After projects completion and installed plugging is no longer required, plugging shall be removed in such a manner that permits sewerage flow to return to normal without surcharging downstream the existing system.

C. The Contractor shall provide the design, installation and operation of the temporary bypass pumping system. The Contractor shall assume responsibility of such bypass pumping system. Bypass system shall meet the requirements of the Oregon Department of Environment Quality (DEQ) and any other State, County or local agencies having jurisdiction over the operation of such facilities.

D. The Contractor will not be permitted to stop mainline flows under any circumstances without prior approval from the City or the Engineer.

E. The Contractor shall assume liability for providing all necessary means to convey sewage past the work area.

F. All water resources, wetlands and other natural resources shall be protected from discharge of sanitary sewers.

**PART 4 SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Payment for all Bypass Pumping shall be included within the lump sum basis for the amount stated on the Bid Form for Construction Facilities, Temporary Controls and Bypass Pumping. A separate payment will not be made for this item.
SECTION 02321 – COMPACTION TESTING

PART 1  GENERAL

1.01  SUMMARY

A. The Contractor shall retain and pay for the service of an approved, recognized independent testing laboratory to conduct laboratory tests on materials and field testing to determine the relative compaction of trench backfill, subgrades, embankments, gravel surfacing, aggregate base and asphalt concrete pavement, as indicated. The approved Testing Agency shall recommend methods of compaction to Contractor and issue final report to the Owner, through the Engineer, regarding compaction testing results and material compliance with the specifications.

B. These specifications call for field compaction efforts to achieve a specified relative compaction for each of the indicated classes of backfill. Determination of in-place density shall be made by means of non-destructive nuclear probe method testing in accordance with ASTM D2922-01 and ASTM D3017-01 test methods.

1.02  DEFINITIONS

Relative Compaction -- The ratio, expressed as a percentage, of the in-place density of the Engineered fill material to the maximum density of the same material as determined by the ASTM D698 Standard Test Method.

PART 2  PRODUCTS

2.01  APPROVED TESTING AGENCIES

A. Carlson Testing, Inc.; 4060 Hudson Ave. NE; Salem, Oregon 97301 (503) 589-1252

B. Foundation Engineering; 820 N.W. Cornell Ave; Corvallis, OR 97330; (541) 757-7645

C. Professional Service Industries (PSI); 1040-A Shelly Street, Springfield, Oregon 97477; (541)746-9649.

D. Other certified private testing laboratory approved by Engineer

PART 3  EXECUTION

3.01  WORKMANSHIP

A. Field Testing

1. Testing to determine the relative compaction of materials placed and compacted by the Contractor shall be performed a short distance behind construction. Tests shall be taken on each lift of the material prior to placement of the succeeding lift to ensure proper compaction is obtained. The Testing Agency shall perform testing at such locations and elevations as to be representative of the entire material and area being compacted. The Engineer shall have authority to require testing at times and locations he deems necessary.

2. A sufficient number of density tests shall be taken on the first section of subgrade and trench backfill placed by the Contractor to establish the effectiveness of the Contractor’s compactive efforts. If tests indicate that the specified relative
compaction for a given material is not being achieved, the Contractor shall modify compaction methods in order to obtain the specified results.

3. A minimum of two (2) tests shall be required to be taken during each site visit. It is estimated that ten (10) site visits will be required for this project.

B. Failing Tests – For areas failing to meet the specified compaction, the Contractor shall be responsible to perform all additional work necessary to achieve specified compaction at no additional cost to the Owner. Additional work may include further compactive effort, moisture treatment, other compaction methods, removal and replacement of failing materials, or other processes required to obtain the specified results.

C. Any subsequent settlement of backfilled areas during the one-year warranty period shall be considered to be the result of insufficient compaction, and shall be promptly repaired by the Contractor at no additional cost to the Owner.

D. The Contractor shall not be allowed any additional compensation for down time incurred as a result of compaction testing or waiting for test results.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Compaction Tests shall be included within the unit prices for sewer lines, service laterals and associated appurtenance items. The price shall include compensation for all costs associated with compaction testing, including sampling, laboratory testing, field testing, administration, and all other work required to obtain certification of backfills placed under this Contract for each type of pipe as shown in the Bid Form.

1. Only Compaction Tests with results meeting the requirements of these Specifications will be accepted. All costs associated with or arising from additional work required due to failing compaction test results, including removal and replacement of material, shall be borne by the Contractor.

2. Contractor must submit invoice from Testing Agency clearly identifying Project, location and date of testing, material tested, test method, test results, specified compaction, maximum dry density of material tested, and number of tests taken. Only tests directed by the Engineer and which obtain passing results will be paid for.

END OF SECTION
SECTION 0230 – EROSION CONTROL

PART 1  GENERAL

1.01  SUMMARY

A.  This section shall include direction and requirements on erosion control for the project. The section should not, however, be considered a comprehensive directive on what erosion control measures will be required on the project. This could vary depending on weather conditions, contractor approach to the work, regulatory agency interaction and requirements, and other factors. The sections should be considered as a general guideline on erosion control issues.

B.  The Contractor shall protect adjacent properties and water resources from erosion and sediment damage throughout the life of the contract in accordance with the ECP described later in this Section.

C.  The Contractor shall comply with all local, state and federal requirements for erosion control including the National Pollutant Discharge Elimination System (NPDES) 1200C Permit if applicable to the project. The Contractor shall be responsible for obtaining said permit and abiding by the requirements of the agencies.

1.02  SUBMITTALS

A.  The Contractor shall submit an erosion control plan (ECP) to the Engineer. The ECP shall incorporate any requirements outlined in the specifications and plans along with additional requirements from DEQ as communicated through the 1200-C permitting process. The ECP will include, at a minimum, the following elements:

1.  Narrative site description

2.  Site map outlining all areas of development, drainage patterns, areas of planned soil disturbance, areas for storage of soils or waste, boundaries of the 100-year flood plain, ordinary high water, location of storm drain outfalls or features, etc.

3.  Erosion control features including BMP and procedures for prevention, runoff control, and sediment control.

1.03  RELATED SECTIONS

A.  Section 02240 – Control of Water

B.  Section 02260 – Shoring and Bracing

C.  Section 02316 – Excavation and Backfill

D.  Section 02320 – Bypass Pumping

E.  Section 02315 – Trench Excavation, Bedding, and Backfill

F.  Section 02900 – Site Cleanup and Landscape Restoration
PART 2 PRODUCTS

2.01 Erosion Control Products – the following products are samples of materials and systems that could be utilized by the Contractor for Erosion control. They do not, however, represent a complete list or requirements for the project.

A. Plastic sheeting: minimum 6 mil thick, polyethylene plastic sheeting for slope protection, spoil pile coverage, and protection of storage and materials.

B. Chemical dust control: non-toxic material that will have no adverse effect on soil structure or establishment and growth of vegetation. Potential products include:
   1. Liquid stabilizer emulsion: a tackifier of liquid and polyvinyl polymers with emulsion resins containing not less than 55% total solids by weight. Do not use tackifiers containing polyacrylates or polyvinyl acrylates.
   2. Dry powder tackifier: A tackifier consisting of one or more active hydrocolloids from natural plant sources which hydrates in water and blends with other slurry materials, and upon application and drying tacks the slurry particles to the soil surface.
   3. Calcium chloride and water for dust control

C. Temporary Mulching: loose hay, straw, netting, wood cellulose, or agriculture silage.

D. Matting or blankets: by American Excelsior or approved equal.

E. Sediment Fencing: fencing that includes a geotextile fabric to screen and hold sediments. Sediment fencing to be capable of supporting its own weight and sediments. Wooden or metal posts shall support the fencing with wire mesh, if required, for additional strength.

F. Bio-filter Bags: Prefabricated bags made from geotextile with filter inserts of biological materials or filtration media manufactured specifically for collecting sediment in drainage inlets or channels.

G. Straw Bales: Standard 45 to 65 pound rectangular straw bales that are wire bound or string tied.

H. Sand Bags

I. Quick growing grasses for temporary seeding.

J. Rip rap for slopes, culvert, storm drain inlets and outlet aprons.

PART 3 EXECUTION

3.01 PREPARATION

A. Contractor to review and carry out the requirements ECP and permit conditions obtained by them through the 1200-C permitting process.

B. Any changes to the ECP should be brought to the attention of the Engineer. A copy of the ECP and approved 1200-C permit must be submitted to Engineer before beginning and site work on the project.
PART 4  SPECIAL PROVISIONS

4.01  MEASUREMENT AND PAYMENT

A. Payment for all erosion control and other work in this section shall be included within the lump sum basis for the amount stated on the Bid Form for Demolition and Site Preparation.

END OF SECTION
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SECTION 02446 – HORIZONTAL DIRECTIONAL DRILLING

PART 1  GENERAL

1.01  DISCRITION

A. This Section includes requirements for Horizontal Directional Drilling (HDD) and related installation of High Density Polyethylene (HDPE) pipe for sanitary sewer force main application.

1.02  QUALITY ASSURANCE

A. HDD Contractor Experience: Actively engaged in horizontal directional drilling for a minimum of 3 years with 8” diameter pipe or larger.

1.03  SUBMITTALS

A. General Information

1. Presentation of similar experience in the last 3 years.

2. References, including: owner name, address, telephone number, contact person, date and duration of work, location, pipe information, and contents handled by pipeline.

B. Project Specific Submittals

1. Working Drawings and written procedure describing in detail proposed method and entire operation for information only including, but not limited to:

   a. Size, capacity and arrangement of equipment.
   b. Location and size of drilling and receiving pits.
   c. Method of removing spoils material.
   d. Method of installing locator wire and pipe.
   e. Method of fusion pipe segment and type of equipment.
   f. Type of cutting head.
   g. Method of monitoring and controlling line and grade.
   h. Detection of surface movement.
   i. Drilling mud information, including:
      i) Product information, material specifications, and handling procedures.
      ii) Material safety data sheet and special precautions required.
      iii) Method of mixing and application.
      iv) Plan showing drilling mud containment during work.

1.01  PROJECT CONDITIONS

A. The HDD portion of this project lies within a wetland area, which is located within an electrical easement and in close proximity to high voltage electrical transmission lines and tower. Contractor shall use caution when performing work in this area.

B. It is Contractor’s responsibility to ensure monitoring and controlling method selected for use is suitable for the existing site conditions.

C. Complete HDD so as not to interfere with, interrupt, or endanger ground surface or structures thereon.

**PART 2  PRODUCTS**

2.01 MATERIALS

A. Pipe and Joints. See Section 02510 – HDPE and PVC Pressure Piping.

1. Use butt fusion joining technique for joining pipe segments installed by HDD. (See Section 02510).

2. When joining pipe at ends of directional drilling runs use butt fusion to join to the adjacent pipe section. (See Section 02510).

3. Mechanical Couplings are not permitted for joining of directional drilled pipe sections.

B. Drilling Fluid.

1. Bentonite drilling mud compatible with the environment.

2. Waste oil or environmentally non-compatible polymers cannot be part of composition.

**PART 3  EXECUTION**

3.01 PREPARATION

A. Excavate pits following submittal drawings and according to the guidelines of Section 02315 – Excavation, Backfill and Other Site Work.

B. Locate and verify any crossing underground utilities before commencing HDD operations.

3.02 OPERATION

A. General.

1. Determine equipment pull strength for drilling length and type of soil encountered.

2. Provide method to control line and grade.

   a. Provide and maintain instrumentation that accurately locates pilot hole.

   b. Drill pilot hole along path following Drawings to these tolerances:

      i) Vertical alignment plus or minus 0.5 foot. Vertical path of the pilot hole must not establish new high points not shown on Drawings.

      ii) Horizontal alignment plus or minus 1.0 foot.

   c. Include electronic monitoring of the horizontal and vertical drilling head location. Obtain an accuracy range within 1 inch of actual position of the pipeline. Record position readings at a maximum of 10 foot intervals.

   d. At completion of pilot hole drilling, furnish Engineer tabulations of horizontal and vertical alignment.
3. When water is encountered.
   a. Provide and maintain a dewatering system of sufficient capacity to remove water.
   b. Keep excavation free of water until backfill operation is in progress.
   c. Perform dewatering in such a manner that removal of soils particles are held to a minimum.
   d. Dewater into a sediment trap with DEQ approved erosion/sediment control measures, as applicable.

4. Maintain close observation to detect settlement or displacement of surface along HDD route.
   a. Notify Engineer immediately if settlement or displacement is detected.
   b. Act to maintain safe conditions and prevent damage to ground surface and any existing adjacent structures.

B. Drilling Operation.

1. Drilling Fluids.
   a. Maintain drilling fluid in bore hole to increase stability of the surrounding soil and reduce drag on pulled pipe.
   b. Dispose of drilling fluid and other spoils at location following laws, ordinances, rules, and regulations of local jurisdiction.
   c. Transport excess fluids and other spoils to the disposal site, at no additional cost to the City.
   d. Minimize drilling fluid at locations other than entry and exit points. Immediately clean up any drilling fluids that inadvertently surface.
   e. Provide clean water for drilling. Contractor may negotiate with City to obtain clean water for drilling as necessary.
   f. Maintain DEQ approved erosion/sediment control measures around bore hole entrance and exit during course of the project as applicable.

2. Pilot Hole Drilling.
   a. Angle entry hole so that curvature of pilot hole does not exceed allowable bending radius of HDPE pipe.
   b. Advance pilot hole with necessary vertical and/or horizontal bends per Plans. Curvature not to exceed allowable bending radius of HDPE pipe.
   c. Alignment Adjustment and Restarts.
      i) Follow pipeline alignment on Plans within tolerances specified herein. Before adjustments, notify Engineer for approval.
      ii) Notify Engineer when forward motion of operation is stopped by an obstruction. Abandon in place with drilling fluid, unless Engineer directs otherwise.

3.03 INSTALLATION

A. Installing HDPE Pipe.

1. Provide a swivel to reaming assembly and pull section of pipe to minimize torsional stress on pull section after drilling pilot hole.

2. Reaming diameter shall be at least one pipe size larger than the outside diameter of pipe being installed.
3. Protect pull section during pull back so that it moves freely and is not damaged on adjacent ground or at entry pit.

4. Pull locator wire along with pipe being installed. Provide locator wire access box at each end of HDD pipe segment.

5. When connecting to adjacent pulled or non-pulled section of HDPE pipe, allow pull section of pipe to extend past termination point.

B. Locator Wire.

1. Install locator wire without splices as shown on Standard Details.

2. Terminate locator wire inside access box using proper sized crimp type connectors on wire ends.

3. Neatly coil at least 18" of slack wire in access box.

4. Test locator wire for continuity following installation.

3.04 FIELD QUALITY ASSURANCE

A. Perform pressure testing of pipe as described in Section 002510 – HDPE and PVC Pressure Piping.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Measurement and payment for Horizontal Directional Drilling of HDPE sanitary sewer force main piping will be made on a unit price basis for the amount stated on the Bid Form per lineal foot of pipe actually installed. Payment shall include full compensation for materials, labor, equipment, excavation of bore and receiving per incidentals necessary for the complete installation of the specified pipe to the limits shown on the Plans or otherwise approved or directed by the Engineer.
SECTION 02450 – JACK AND BORE CASING PLACEMENT

PART 1  GENERAL

1.01 DISCRPTION

A. This Section includes requirements for installing, conduits, pipes, casings, linings and sleeves by tunneling, boring and jacking methodology without excavation or removal of the overlying asphalt surface.

1.02 QUALITY ASSURANCE

A. Boring/ Jacking Contractor Experience: Shall be actively engaged in boring/ jacking casing placement for a minimum of 3 years with a minimum of 8” diameter pipe and larger.

1.03 SUBMITTALS

A. General Information

1. Presentation of similar experience in the last 3 years.

2. References, including: owner name, address, telephone number, contact person, date and duration of work, location, pipe information, and contents handled by pipeline.

B. Project Specific Submittals

1. Working Drawings and written procedure describing in detail proposed method and entire operation for information only including, but not limited to:

   a. Size, capacity and arrangement of equipment.
   b. Location and size of jacking and receiving pits.
   c. Method of removing spoils material.
   d. Method of installing locator wire and pipe.
   e. Method of fusion pipe segment and type of equipment.
   f. Type of jacking/ cutting head.
   g. Method of monitoring and controlling line and grade.
   h. Bracing to prevent pipe shift and floatation of carrier pipe.
   i. Backfill material or pressure grout mix, including:
      i) Product information, material specifications, and handling procedures.
      ii) Material safety data sheet and special precautions required.
      iii) Method of mixing and application and placement.
      iv) Equipment required for placement
   j. Stamped working drawings for jacking pit bracing and shield.

1.01 PROJECT CONDITIONS

A. Complete boring/ jack placement of casing pipes so as not to interfere with, interrupt, or endanger existing ground surface or structures thereon.

PART 2 PRODUCTS

2.01 MATERIALS

A. Smooth Steel Casing – Casing pipe as installed by boring and jacking shall be welded steel pipe conforming to ASTM 53 and shall have a 35,000 P.S.I. min. yield and shall be to the size as required to case the carrier pipe as shown on the plans unless otherwise noted.

   a. Casing pipe shall be of a size capable to house the carrier pipe and fittings

B. Carrier Pipe – shall be PVC SDR26 sewer pipe with bell restraint joints as specified in Section 02530 Gravity Sewer Pipe and Fittings.

PART 3 EXECUTION

3.01 PREPARATION

A. Excavate pits following submittal drawings and according to the guidelines of Section 02315 – Excavation, Backfill and Other Site Work.

B. Pothole and verify depth and location of any crossing underground utilities before commencing boring and jacking operations to avoid any conflicts and/or hazards.

C. Any section of storm drain or any other utility that is in the vicinity of the jack and bore shall be cut and replaced if needed to complete the installation.

3.02 OPERATION

A. General – unless otherwise specified or directed, encasement pipe shall be welded steel pipe as installed by boring and jacking. No open trench excavation will be allowed within the limits of the encasement path without Engineers approval. All sheeting, shoring and bracing shall be provided as required for safe placement of casing pipe.

1. When water is encountered.

   a. Provide and maintain a dewatering system of sufficient capacity to remove water.
   b. Keep excavation free of water until backfill operation is in progress.
   c. Perform dewatering in such a manner that removal of soils particles are held to a minimum.
   d. Dewater into a sediment trap with DEQ approved erosion/sediment control measures, as applicable.

2. Maintain close observation to detect settlement or displacement of surface along bore and jacking route.

   a. Notify Engineer immediately if settlement or displacement is detected.
   b. Act to maintain safe conditions and prevent damage to ground surface and any existing adjacent structures.

B. Bore and Jacking Operation.

1. Provide a solid aggregate base or as required to support the weight of the boring equipment and casing.
2. Set track, casing pipe and shoring to line and grades as required to complete boring and jacking placement of new casing.

3. The work shall be performed in such a manner that no voids occur in the earth surrounding the casing pipe and so that any ground settlement adjacent to and within the limits of the casing pipe crossing is eliminated.
   a. If voids occur or are encountered during the bore and jacking, grout holes shall be drilled and set on 10-foot centers to the top of the encasement pipe and filled with 1:3 Portland cement grout.
   b. Grout shall be applied at sufficient pressure as required to fill the voids and prevent any embankment settlement.
   c. If the bore and jacking must be abandoned due to voids or an incomplete and/or unacceptable bore location. The abandoned encasement shall be capped and filled completely with 1:3 Portland cement grout. Abandonment and grout filling of abandoned encasement shall be completed prior to moving to another boring location if required.

C. Excavated materials and spoils from the boring and jacking shall be disposed of as specified in Section 02315 Trench Excavation & Backfill.

3.03 INSTALLATION

A. Installing Casing Pipe.
   1. Casing sections shall be joined by full circumference welds. Contractor shall utilize multiple passes of welds to ensure full penetration of welds and that the joints can withstand the jacking forces of the installation.
   2. Sections of auger and casing pipe shall be added together and jacked until the final length has been reached.

B. Carrier Pipe.
   1. Carrier pipe shall be installed in a manner as to provide proper line and grade.
   2. Provide insulators and/or spacers to prevent movement and floatation.

C. Grout Filling Casing Pipe.
   1. Upon completion of installation of carrier pipe completely fill the annular space between the carrier pipe and casing with approved sand or grout.
   2. Pump or place grout / sand from the two ends and from intermediate points if required in one continuous operation without stopping.
   3. Grout seal end caps between carrier pipe and casing upon completion.

3.04 FIELD QUALITY ASSURANCE

A. Perform pressure testing of carrier pipe as described in Section 02516 – HDPE and PVC Pressure Piping.
PART 4  SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Measurement and payment for Bore/ Jack Casing placement will be made on a unit price basis for the amount stated on the Bid Form per lineal foot of casing pipe actually installed. Payment shall include full compensation for bore pit excavation, all materials, labor, and equipment to make push / jack, and incidentals necessary for the complete installation of the specified casing pipe to the limits shown on the Plans or otherwise approved or directed by the Engineer.

B. Measurement and payment for Carrier Pipe (Sewer Line) will be made on a unit price basis for the amount as stated on the Bid Form per lineal foot of Carrier Pipe installed. Measurement for payment quantities shall be based on horizontal length and shall include compensation for labor, pipe insulators or spacers, joint restraints, sand fill and grout end caps flushing, testing and disinfection all as required for a complete installation.

C. Measurement for carrier pipe fittings and appurtenances shall be as identified within Section 02530 Gravity Line Pipe.

END OF SECTION
SECTION 02501 – DUCTILE IRON PIPE AND FITTINGS

PART 1  GENERAL

1.01  SUMMARY

A.  The work in this Section consist of furnishing all labor, materials, equipment and performing all work necessary for the proper installation of Ductile Iron Pipe materials, as indicated on Plans, for sewer transmission pressure mains, including fittings, anchors, complete installation and testing.

B.  All work shall conform to the latest version of the Oregon Standard Specifications (OSS) Part 00400, except as specified herein and shown on the Plans.

C.  Pipe appearances, also see Section 15110.

D.  Submittals shall be as specified in Division 1 – Section 01300.

1.02  REFERENCES


H.  AWWA C 600 – Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

PART 2  PRODUCTS

2.01  MATERIALS

A.  All pipe, fittings and appurtenances shall be new and unused, unless specified in the plans or in writing from the Engineer.

B.  Bends, tees, reducers, and all other fittings required for piping systems shall be ductile iron fittings cast with tested and traceable ASTM A536 Ductile Iron, with mechanical joint (MJ), flanged ends (FE), or plain ends (PE), unless otherwise shown in the Drawings.

C.  Ductile Iron Pipe Barrels:
1. Shall bear the mark of the Underwriter’s Laboratories approval

2. Shall provide a minimum thickness Class 53 for flanged pipe and thickness Class 52 for sanitary sewers.

D. Pressure class to be a working pressure of 150 psig or the total dynamic head of the sewer lift station pump, whichever is greater.

E. Clearly mark pipe section to show location and thickness/pressure class.

2.02 JOINTS

A. Joint types: ANSI A 21.11 push-on; ANSI A 21.11, mechanical joint; or ANSI A 21.16 flanged end. For bolted joints, conform to requirements of AWWA C111; provide minimum 304 stainless steel for restrained joints.

B. Threaded or grooved-type joints which reduce pipe wall thickness below minimum required are not acceptable.

C. Provide for restrained joints designed to meet test pressures required under Section 02510 – HDPE Pressure Pipe. Provide restrained joints for test pressure or maximum surge pressure as specified, whichever is greater. Do not use passive resistance of soil in determining minimum restraint lengths.

2.03 GASKETS

A. Furnish, when no contaminant is identified, plain rubber (SBR) gasket material in accordance with ANSI A21.11 or ASTM F 477 (One Bolt only); for flanged joints 1/8-inch-thick gasket in accordance with ANSI A 21.15.

2.04 FITTINGS

A. Use fittings of same size as pipe. Reducers are not permitted to facilitate an off-size fitting, only for transitions as indicated on plans. Reducing bushings are also prohibited. Make reductions in piping size by reducing fittings. Line and coat fittings as specified for pipe they connect to.

B. Push-on Fittings: ANSI A 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.

C. Flanged Fittings: ANSI 21.10; ductile iron ANSI A 21.11 joints, gaskets, and lubricants; pressure rated at 250 psig.

D. Mechanical Joint Fittings: ANSI A 21.11; pressure rated at 250 psi.

2.05 COATINGS AND LININGS

A. Reference Section 09900: Paints and Coatings

PART 3 EXECUTION

3.01 PIPE INSTALLATION
A. Force main pipe shall be installed, stored and handled in accordance with the manufacturer's installation guide and these specifications.

B. For pipes with external coating, do not roll or drag pipe on ground. Move pipe in such a manner as not to damage pipe or coating. Carefully, inspect pipe for abrasions and repair damaged coating before pipe is installed.

C. Remove material from job site, which in the judgment of the Engineer is damaged, not as specified, or otherwise rejected. Payment will not be made for damaged or rejected materials, their removal, or for repairs to such materials.

D. Thoroughly clean inside the pipe before laying. Prevent foreign material from entering the pipe while it is being placed in the trench. Remove all foreign material from the inside of the pipe and joint before the next pipe is placed. Keep debris, tools, rags or other materials out of the pipes at all times. When pipe laying is not in progress, seal the open end of the pipe with a watertight plug, or by other approved means to prevent the entry of water or other foreign materials into the pipe.

E. Lay pipe with bell ends facing the direction of laying. For lines on an appreciable slope, face bells up-grade unless otherwise directed by the Engineer. Thoroughly clean the ends of the pipe to remove all foreign matter from the pipe joint. Lubricate the bell and spigot ends with approved pipe lubricant, as recommended by the manufacturer.

F. All pipes shall be thoroughly flushed with water prior to testing. The Contractor shall be responsible for the removal of all debris that enters into the sewer system from construction. All costs associated with removal of such debris shall be the responsibility of the Contractor and result in no additional costs to the Owner.

3.02 EXTERNAL COATING SYSTEM FOR PIPE INSTALLED ABOVE GROUND AND IN VAULTS

A. See Section 09900: Paints and Coatings

3.03 HYDROSTATIC TESTING OF FORCE MAIN SEWER (per UNI-B-3)

A. After the pipe has been installed and flushed, test line and drain. Prevent damage to Work or adjacent areas. Use clean water to perform tests.

B. Test pipe in presence of Engineer and District representative.

C. Test pipe at 150 psig or 1.5 times the design pressure of the pipe, whichever is greater. Design pressure of force main shall be rated for the total dynamic head of the lift station pump.

D. Test pipe at required pressure for a minimum of 2 hours according to the requirements of UNI-B-3.

E. Maximum allowable leakage shall be as calculated by the following formula:

\[ L = \frac{(S)(D)(P^{0.5})}{133,200} \]

Where:
- \( L \) = Leakage allowable, in gallons per hour
- \( S \) = Length of pipe, in feet
- \( D \) = Inside diameter of pipe, in inches
- \( P \) = Pressure, in pounds per square inch
F. Correct defects, cracks, or leakage by replacement of defective item(s) or by repairs, as approved by the Engineer and Owner. All costs associated with removal or replacement of defective items shall be the responsibility of the Contractor and result in no additional costs to the Owner.

G. Contractor shall record and document the testing procedure and results during the testing process. The UNI-Bell "Air Test Data Sheet" or similar approved equal shall be used and submitted to the Engineer. Record the diameter (in), length (ft), location, time, date, pressure drop, and groundwater level on inspection form.

**PART 4  **SPECIAL PROVISIONS

4.01  MEASUREMENT AND PAYMENT

A. Payment for Ductile Iron Pipe and Fittings shall be included within the lump sum basis for the amount stated on the Bid Form for Ductile Iron Site Piping, Valves and Fittings. No additional payment will be made for ductile iron pipe for the project.

END OF SECTION
SECTION 02510 – HDPE PRESSURE PIPING

PART 1  GENERAL

1.01  SUMMARY

A.  This work consists of furnishing all labor, materials, incidentals and equipment, and performing all work for the furnishing, installation and testing of HDPE pressure pipe required for the completion of the proposed project. Valves, and other fittings and appurtenances shall be as specified in Section 15110.

B.  Applies to sewer pressure pipe.

PART 2  PRODUCTS

2.01  MATERIALS

A.  High Density Polyethylene (HDPE) Pipe

1.  HDPE pipe shall be made from polyethylene resin compound with a minimum cell classification of PE 645464C for PE 3408 materials as determined by ASTM D3350-02. This material shall be a Plastic Pipe Institute (PPI) listed compound and analyzed by ASTM D2837. The material shall be listed and approved for potable water service in accordance with NSF Standards 14 and 61.

2.  Pipe sizes 1-1/4-inch diameter and greater shall be DR11, Class 160, IPS and shall be manufactured to the requirements of ASTM F714 and AWWA C906-99 (IPS) and shall be of standard pipe lengths (40 or 50 foot) or a continuous roll. HDPE pipe shall be DriscoPlex 4100 IPS HDPE pipe; Isco industries or approved equal.

3.  Sewer force main for directional drill shall be DR 11, PE 3408/4710 IPS HDPE and shall be manufactured to the requirements of ASTM F714 and AWWA C906-99 (IPS) and shall be of standard pipe lengths (40 or 50 foot lengths) or a continuous roll. NSF 14 and 61 compliance is not required. HDPE pipe shall be DriscoPlex 4100 IPS HDPE pipe; Isco industries or approved equal.

4.  Pipe shall be provided with a continuous mark made of durable printing containing the following:

a.  Name and/or trademark of pipe manufacture, nominal pipe size and dimension ratio.

b.  The manufacturing standard reference ASTM F714 and polyethylene grade per ASTM D3350.

5.  Butt fusion fittings and pipe shall comply with ASTM D3261.

6.  Electrofusion fittings shall comply with ASTM F1055.

7.  Mechanical (compression) fittings used with polyethylene pipe shall be specifically designed for, or tested and found to be acceptable for, use with polyethylene pipe.
8. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.

9. HDPE BENDS
   a. Bends refer to any horizontal or vertical bend in the pipe. Bends requiring elbows shall be butt fusion welded (see section 02510, part 3).
   b. Maximum pipe bending radius shall be in conformance with the manufacturer's recommendation for the specific diameter and dimension ratio (DR) of the pipe. Whenever possible, changes in direction shall be accomplished by bending the pipe in lieu of installing a fitting, except as approved by the Engineer.

PART 3 EXECUTION

3.01 GENERAL
   A. Materials shall not be distributed on the job faster than can be used to good advantage. Sites shall be maintained clean and safe at all times. The Contractor shall supply all necessary signing and flagging to provide for a safe working environment.
   B. Remove from the job site material which, according to the judgment of the Engineer, is damaged beyond repair or otherwise has been rejected. Payment will not be made for damaged or rejected materials, their removal, or for repairs to such materials.
   C. Excavate and prepare trench as specified in Section 02315. Place any required foundation stabilization and compact pipe bedding prior to laying pipe.

3.02 HDPE PIPE INSTALLATION
   A. Fusion
      1. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground. The joining method shall be the butt or electrofusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations.
      2. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer, including, but not limited to, temperature requirements of 400 degrees Fahrenheit, alignment, and an interfacial fusion pressure of 75 PSI. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.
      3. All electrofusion field welds shall be made with fusion equipment equipped with a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the Quality Control records.
      4. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer's specifications. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the
HDPE pipe being fused. The size of heating iron shall be ¼ inch larger than the size of the outlet branch being fused.

5. Mechanical joining will be used where the butt fusion or electrofusion method cannot be used. Mechanical joining will be accomplished by either using a HDPE flange adapter with a Ductile Iron back-up ring or HDPE Mechanical Joint adapter with a Ductile Iron back-up ring. Method of mechanical joining shall be as indicated on the Plans.

6. Socket fusion, hot gas fusion, threading, solvents, glues, and epoxies will not be used to join HDPE pipe.

B. Inspection – Inspect the pipe for defects before installation and fusion. Defective, damaged or unsound pipe will be rejected.

3.03 FILLING AND FLUSHING

A. After installation of sewer piping, fill pipes slowly with potable water at a maximum rate of 10 cfs while venting all air. Take all required precautions to prevent entrapping air in the pipes. Flush all sections of pipe to remove any solids or material that may be in the pipe. If no hydrant is installed at the end of the main, provide a tap large enough to develop sufficient flow rates to achieve a velocity between 3 to 5 feet per second in the main. Control and dispose flushing water in a proper manner to avoid erosion, flooding, property damage, and discharge of chlorinated water in an unacceptable manner.

B. All sewer lines shall be flushed as specified herein as to remove any foreign material. The contractor shall provide all fittings and backflow preventions as required to perform the flushing.

C. All sewer lines six (6) inches and larger shall be “pigged” as specified herein to remove any foreign matter. All sewer lines and service lines four (4) inches and smaller shall be flushed to remove any foreign matter.

1. “Pigging” shall be accomplished prior to hydrostatic testing and disinfection.

2. A minimum of three (3) pigs shall be flushed through the sewer lines. The Contractor has the option of running all three pigs at the same time or running the pigs one at a time. Identify individual pigs if all three pigs are to be ran simultaneously.

3. Pigs shall be polyurethane form as manufactured by Knapp Poly Pig, Inc. or as approved by Engineer.

4. It shall be the responsibility of the Contractor to flush the pigs through the sewer lines and retrieving pigs after the test. If one or more pigs fails to run the complete length of the sewer line, Contractor shall be responsible for retrieving the pigs and repeating the test.

5. Contractor shall provide erosion control as required to prevent damage to surrounding vegetation and existing ground.

6. The Contractor shall re-pig the sewer lines as required if after pigging and disinfection of the treated sewer lines, the bacteriological test fails.
7. Contractor shall notify Engineer and Owner a minimum of 24-hours prior to pigging the sewer lines. Engineer can require sewer lines to be re-pigged if excessive foreign material is encountered during pigging.

8. The contractor shall be required to temporarily remove and replace any reducers, pipe spools and fittings as required placing and removing pigs for the flushing.

3.04 PRESSURE TESTING

A. All newly installed pressure lines shall be tested before being placed in service. Prior to conducting tests, all air shall be expelled from the pipe. Contractor shall install taps at high points of the line for the purpose of expelling air.

B. Hydrostatic pressure testing shall be conducted after the force main has been flushed.

C. All service lines, and force mains shall be subjected to hydrostatic pressure testing. Testing shall be conducted by the Contractor in the presence of the Engineer or Owners representative. Engineer and Owner shall be notified at least 2 working days in advance.

D. Testing shall not be commenced until all thrust blocking has been in place for not less than 10 days and sufficient backfill has been placed to prevent pipe movement.

E. Furnish and operate all pumps, gauges, plugs, saddles, corporation stops, miscellaneous hose and piping, and measuring equipment necessary for performing the test. Provide certifications of accuracy for gauges from an approved laboratory when requested.

F. Test Procedure

1. Conduct per ASTM F 2164. The test section shall be slowly filled with water and all air expelled from the pipe prior to testing. Procedure involves an initial expansion, and test phases.

2. All valves isolating the test section shall be securely closed and the specified test pressure applied by means of a pump connected near the lower end of the test section.

3. Apply initial pressure of 160 psi and allow to stand for 3 hours to allow for diametric expansion or pipe stretching to stabilize. Add make-up water as required to maintain the pressure for the 3-hour period.

4. After this equilibrium period, apply the specified test pressure and turn the pump off.

5. The test pressure shall be 150 psi and the duration shall be at least 1 hour at the test pressure. If after the 1-hour test period the pressure remains steady (within 5%), leakage is not indicated.

6. If leaks are discovered, depressurize the test section before repairing leaks. Correctly made fusion joints do not leak. Leakage at a butt fusion joint may indicate imminent catastrophic rupture. Depressurize the test section immediately if butt fusion leakage is discovered. Leaks at fusion joints require the fusion joint to be cut out and redone.

7. Depressurize test section of pipe and conclusion of testing period by utilizing a controlled release of the testing liquid. If the test is not completed due to leakage, equipment failure, or for any other reason, that section of line being tested shall
be depressurized completely and allowed to relax at least eight (8) hours before pressurizing the test section of pipe.

G. All visible leaks on new force main line shall be repaired, regardless of the amount of leakage.

PART 4  SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Sewer Pipe and other work in this section shall be included as a portion of the unit price for 10-inch HDPE Force Main as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 02511 – LOCATOR WIRE & WARNING TAPE

PART 1  GENERAL

1.01 SUMMARY

A. This section consists of furnishing all labor, material and equipment, and performing all work required for the burying of an insulated copper conductor wire and plastic underground warning tape in the trench with installed non-ferrous and/or nonconductive (plastic, etc.) water and sewer lines. See the Standard Detail Drawings for trench cross section.

PART 2  PRODUCTS

2.01 MATERIALS

A. Sewer Lines

1. Tracer wire shall be No. 12 AWG, solid copper with green colored insulation. Insulation shall be 0.030-inch thick HDPE designed for direct bury.

2. Underground warning tape shall be 6-inch wide, 4-mil thick, APWA Standard Green color, reading “CAUTION – BURIED SEWER LINE BELOW.”

B. Horizontal Directional Drill Installations

1. Tracer wire for HDD installations shall have steel core with copper cladding and HDPE insulation. Insulation shall be 0.045-inch thick. Minimum gage is 12 AWG. Colors shall be as above. Pro-Trace HDD-CCS; Copperhead SoloShot EHS; DURAtrace DD; or approved equal.

PART 3  EXECUTION

3.01 WORKMANSHIP

A. Sewer Lines

1. Wire and warning tape shall be buried the entire length of the trench, placed in accordance with the Standard Detail Drawings, for all nonconductive pipelines.

2. Wire shall be brought to the surface and connected at each manhole and sewer cleanout. Distance between tracer lead access locations shall not exceed 1,000 feet. All joints and/or splices in the wire shall be made with a designed waterproof splice kit. Wire shall be taped to pipe every 5 feet and shall be run straight with a small amount of slack. Wire shall be routed outside each manhole or cleanout riser. Wire shall be exposed inside all cleanout covers and provide a minimum of 24” of wire provided. At manholes, pass wire into manhole between concrete grade ring and manhole lid frame and provide a minimum of 24” coiled wire.

3. Warning tape shall be placed over the pipe zone material, approximately 15 to 18 inches below finish grade, in accordance with the Standard Detail Drawings. Lay tape flat and untwisted, centered over the pipe and with wording facing upwards.
PART 4  SPECIAL PROVISIONS

4.01  MEASUREMENT AND PAYMENT

A.  Payment for Locator Wire & Warning Tape shall be included within the lineal footage prices for each size and backfill class of Sewer Line to be installed. No additional compensation will be allowed.

END OF SECTION
SECTION 02520 – PRECAST CONCRETE VALVE VAULT

PART 1  GENERAL

1.01 SUMMARY

A. This item shall include furnishing and installing the pre-cast concrete valve vault as required for the new site piping and appurtenances as identified on the Plans.

B. The valve vault shall be pre-cast unless otherwise specified or approved by the Engineer. The valve vault shall conform to the size, dimensions and location as shown on the plans.

C. Contractor shall provide manufacturer's certifications, including test results for all piping, fittings and appurtenances supplied and shall submit special procedures for pre-cast concrete valve vault installation. All submittals shall be in conformance with the requirements of Section 01300.

PART 2  PRODUCTS

2.01 MATERIALS

A. Valve Vault

1. Valve vault shall be reinforced precast concrete base, vault and flat top lid to the size shown on the Details in the Plans. All component shall be structurally sufficient for intended use meeting the requirements of ASTM C857 'Minimum structural design loading for underground precast concrete utility structures'.

2. Valve vault sections base, vault and cover shall be fabricated as a keylock type suitable for placement of gasket material.

   a. O-ring rubber gaskets shall be in accordance with ASTM C443.

   b. Butyl rubber gaskets shall be in accordance with ASTM C990.

3. The flat top lids and hatches shall withstand H-20 loading. Hatches shall be a double set of doors that shall be lockable and constructed of aluminum and/or galvanized steel with stainless steel hardware.

4. Valve vault shall be 7’x8’x4.5’

5. Meter Vault shall be 8’x4’x4.5’

PART 3  EXECUTION

3.01 VAULT INSTALLATION

A. Excavation for vault shall comply with the pertinent sections of Section 02315 Trench Excavation, Bedding & Backfill and Section 02316 Excavation & Select Backfill.

B. Place and compact twelve (12) inches of aggregate base as shown on the details and plans.
C. Install rubber gaskets between vault sections as in accordance with manufacturer's recommendations.

D. Vault wall penetrations shall be watertight seal or grout as required.

**PART 4  SPECIAL PROVISIONS**

4.01  MEASUREMENT AND PAYMENT

A. Payment for the new Precast Concrete Valve Vault shall be as specified on the unit price basis for the amount stated on the Bid Form.
SECTION 02530 – GRAVITY SEWER PIPE AND FITTINGS

PART 1  GENERAL

1.01 SUMMARY

A. This section covers gravity sewer pipe materials for sewer mains and service laterals, including fittings, anchors, complete installation and testing.

B. All work shall conform to the latest version of the Oregon Standard Specifications (OSS) Part 00400, except as specified herein and shown on the Plans.

C. Any necessary testing shall conform to the 2018 Oregon Standard Specifications for sewer gravity pipe.

PART 2  PRODUCTS

2.01 MATERIALS

A. All pipe, fittings and appurtenances shall be new and unused.

B. 4-inch through 15-inch PVC Gravity Sewer Pipe and Fittings

1. Unplasticized polyvinyl chloride (PVC) plastic gravity sewer pipe with integral wall bell and spigot joints for the conveyance of domestic sewage. Pipe shall be colored green for identification as sewer pipe. Pipe shall be furnished in 20-foot laying lengths. Pipe shall meet ASTM D3034 and have an SDR of 35.

2. PVC compounds shall meet the requirements of ASTM D1784, cell classification 12454-B.

3. Bells shall consist of an integral wall section with a solid cross-section rubber ring, factory assembled, and securely locked in place to prevent displacement during assembly. Spigot ends shall be supplied from the factory with beveled ends. Joints shall provide a tight flexible seal meeting the requirements of ASTM D3212. Material used for elastomeric seal in push-on joints shall meet the requirements of ASTM F477.

4. All fittings and accessories shall be as manufactured and furnished by the pipe supplier, or approved equal, and shall have bell and/or spigot configurations compatible with that of the pipe. Fittings shall meet the same requirements as the pipe.

5. All fittings and appurtenances required to construct laterals and cleanouts shall be PVC and provided by or approved by the same manufacturer as the sewer piping. This shall include all tees, caps, wyes, couplings and other required fittings.

6. Pipe and fittings shall be Ring-Tite PVC Gravity Sewer Pipe and Fittings as manufactured by Certainteed, Simpson, PW Pipe, J-M Manufacturing Company, Inc.; or approved equal.

C. Appurtenances
1. Transition couplings and same diameter couplings for new sewer lines, unless otherwise specified, shall be flexible rubber with stainless steel bands. Fernco, or approved equal. Rotate coupling so type and size wording is visible from top to allow for inspection.

2. PVC pipe connections to concrete manholes shall utilize appropriately sized flexible, watertight seal adapters designed for such use. Adapters shall be tested watertight to a minimum of 10.8 psi during factory testing. Adapters shall be for connections to precast concrete shall be KOR-N-SEAL as manufactured by NPC, Inc.; or approved equal. Adapters for connections at cast-in-place manhole bases shall be made with a rubber waterstop grouting ring. Ring shall clamp to pipe with stainless steel clamp and have waterstop ribs. Waterstop Grouting Ring by Press-Seal Gasket Corp., or approved equal.

3. New service lateral connection to existing sewers shall utilize one of the following clamp on style saddles:
   a. Molded PVC saddle with neoprene rubber seal to sewer main, gasket branch, and stainless steel straps; conform to ASTM D3034; GPK or approved equal.
   b. Cast ductile iron saddle with virgin SBR gasket and adjustable 3½” wide stainless steel strap; Romac Style “CB” or approved equal.

4. Manufactured tees shall be required for service lateral connections to new mains and lateral reconnections to existing mains where use of saddles is not feasible. Tees shall conform to subsection 2.01.B. above.

5. Cleanouts shall be constructed of the same PVC material as used to construct the service lateral piping. Cleanout size, fittings, and cleanout cover shall be as shown in the Standard Detail Drawings.

D. Concrete shall conform to Oregon Standard Specifications Section 00440, Commercial Grade Concrete. Compressive field strength shall not be less than 3,000 psi at 28 days. Maximum aggregate size shall be 1½-inches. Slump shall be between 2 and 4 inches.

E. Non-Shrink Grout. Grout shall be Sika 212, Euco N-S, Five Star, or approved equal nonmetallic cementitious commercial grout exhibiting zero shrinkage per ASTM C827. Grout shall not be amended with cement or sand and shall not be reconditioned with water after initial mixing. Nonshrink grout shall be placed and packed only with the use of an approved commercial bonding agent. Unused grout shall be discarded after 20 minutes.

**PART 3  EXECUTION**

3.01 PIPE INSTALLATION

A. PVC pipe shall be installed and handled in accordance with the Uni-Bell Plastic Pipe Association standards UNI-B-3, these specifications and the manufacturer’s installation guide. The Contractor shall have on site all proper tools and equipment to properly and safely install the pipe.

B. Remove material from job site, which in the judgment of the Engineer is damaged, not as specified, or otherwise rejected. Payment will not be made for damaged or rejected materials, their removal, or for repairs to such materials.
C. Preparation of Trench – Excavate and prepare trench for pipe laying to the lines and grades as specified and shown on the Plans. Place any required foundation stabilization and compact pipe bedding prior to laying pipe. Stabilize trench as required and comply with OSHA safety provisions.

D. Place and compact pipe bedding material before placing pipe in the trench. Dig depression for pipe bells to provide uniform bearing along the entire pipe length. Thoroughly compact bedding material to prevent future bellies.

E. Prior to lowering pipe into the trench, the Engineer and City representative will check for damage to the pipe. The Contractor shall repair or replace, as directed, all damaged or flawed pipe prior to installation.

F. Thoroughly clean inside the pipe before laying. Prevent foreign material from entering the pipe while it is being placed in the trench. Remove all foreign material from the inside of the pipe and joint before the next pipe is placed. Keep debris, tools, rags or other materials out of the pipe at all times. When pipe laying is not in progress, seal the open end of the pipe with a watertight plug, or by other approved means to prevent the entry of trench water or other foreign materials into the pipe.

G. Lay pipe with bell ends facing the direction of laying. For lines on an appreciable slope, face bells up-grade unless otherwise directed by the Engineer. Thoroughly clean the ends of the pipe to remove all foreign matter from the pipe joint. Lubricate the bell and spigot ends with approved pipe lubricant, as recommended by the manufacturer.

H. Tolerance. For gravity pipelines, vertical deviation from true grade shall not exceed 0.02 feet (0.24 inch). Horizontal tolerance for deviation from line shall be 0.03125 feet (3/8 inch). Depressions or bellies which create the potential for solids deposition are not allowed.

I. Where new sanitary sewer pipe is installed near existing or new water lines, all provisions of current OAR 333-61-050 (Crossings – Sanitary sewers and waterlines), regarding placement of pipe near, under, or over water lines shall be followed, or as directed in these construction documents.

J. Where existing driveway culvert pipes or other drainage structures that are removed for ease of construction shall be replaced with the same pipe size without additional cost to the Owner. Existing pipe may be reused if not damaged and approved by the Engineer.

K. Care must be taken to ensure the pipe is not moved and the side support fill is not disturbed when moving sheeting or trench boxes.

L. Place materials in the pipe zone in layers not greater than 6 inches thick and in a manner that equalizes the pressure on the pipe and minimizes stress. As required under the haunches of pipe and areas not accessible to mechanical tampers or to testing, compact with hand methods to ensure thorough contact between the material and the pipe. Before placing the pipe zone material, condition, aerate, or wet the material so that the moisture content of each layer is within minus 4% to plus 2% of optimum moisture content.

M. Provide proper Backfill Class material as required. Backfill the trench above the pipe zone in successive lifts. Do not allow the backfill to free-fall into the trench until at least 3 feet of cover is provided over the top of the pipe. Modify the compaction as necessary to protect the pipe. Compact each lift to not less than 95% of the maximum density.
N. All pipes shall be thoroughly flushed with water prior to testing. Removal of water and debris shall be accomplished by exposing the pipe on the low end of the gravity main in each section and pumping water from the trench to the ground surface for disposal. The Contractor shall be responsible for the removal of all debris that enters into the sewer system from construction. All costs associated with removal of such debris shall be the responsibility of the Contractor and result in no additional costs to the Owner.

O. Service laterals shall be installed at a minimum 2% slope from the mainline or manhole to the connection with the existing lateral from the building, unless otherwise approved by the Engineer. Provide couplings for connection to existing service laterals. Coordinate with home-owner.

P. Service Lateral Connections

1. Service lateral connections shall include the connection of any new or existing service lateral to the main at locations shown on the Plans. Service laterals shall be connected to the main using new manufactured tees or wyes, as specified. In general, tees will be used where new laterals are being added along new mains or where existing laterals are being replaced and reconnected to the new main.

2. The Contractor shall install new PVC tees or wyes with manufactured bends as shown on the Standard Details. Service lateral piping shall be extended from the new connection to the point where the existing service lateral crosses into the public right-of-way, and connected to the existing piping.

3. The Contractor shall provide a minimum of 1-hour notice to any existing user prior to cutting the user’s service lateral and thereby disrupting service. Lateral replacement shall be completed within 4-hours or the Contractor will be required to provide bypass pumping for the affected service.

4. The Contractor shall be responsible for all exploratory excavation and/or video inspection necessary to locate existing service laterals.

5. Service laterals shall be neatly cut at the property line and removed to the point of connection to the mainline. Reconnection to existing lateral piping shall be made using an appropriately sized transition coupling, as specified. The contractor shall install new PVC cleanouts at property line as shown on the Standard Details.

6. Where existing tees on the sewer main are cracked, broken, or otherwise unusable, the Contractor shall install a new tee and necessary mainline piping in order to provide a watertight connection for the lateral.

Q. After installation and compaction of backfill, all pipe shall be thoroughly flushed and then subject to either hydrostatic or low-pressure air testing. Pipe will also be tested for deflection and will be video inspected.

R. Pipe Jointing

1. Thoroughly clean the ends of the pipe to remove all foreign matter from the pipe joint. Lubricate the bell and spigot ends with NSF approved pipe lubricant, as recommended by the manufacturer.

2. Furnish the gaskets required for the joint being assembled. Install the gasket with uniform tension around the joint groove before placing the pipe in the trench.

3. Solvent weld joints shall be installed according to ASTM D2855-90.
3.02 MANHOLE CONNECTIONS

A. Where shown on the Plans or directed by the Engineer, the Contractor shall connect new sewer piping to existing manholes.

B. Core drill the manhole wall using appropriately sized core drill for the new pipe. Jackhammering will not be allowed. Install pipe in accordance with Section 02635 using KOR-N-SEAL boot.

C. When an existing manhole has a poured-in-place base or other obstruction at the pipe level and core drilling is not feasible, contractor may jackhammer to provide penetration for new or replacement pipe. Install pipe in accordance with Section 02635 using Waterstop Grouting Ring.

D. Install flexible transition couplings on all pipes within 2 feet of the outside walls of manholes. Provide a watertight connection.

E. Modify the base of the manhole in accordance with Section 02635-3.03.

3.03 PLUG AND ABANDON PIPING/LATERALS

A. Install an appropriately sized mechanical plug at least 2-feet into the pipe or lateral designated for plugging or abandonment.

B. Concrete slurry for sealing sewer lines and laterals being abandoned shall consist of 2 sacks of Portland cement per cubic yard of cement sand. Water shall be added at such a ratio as to provide a 4-inch slump.

C. Concrete slurry shall be packed into the end of the pipe up to the mechanical plug and troweled flush with the end of the pipe.

3.04 VIDEO INSPECTION OF GRAVITY SYSTEMS

A. All gravity sewer lines constructed as part of the project shall be televised and taped at the end of construction prior to acceptance. Taping shall be conducted after all backfill and compaction, but prior to final surface restoration. All pipes shall be thoroughly flushed by the Contractor immediately prior to the video inspection. A 1-inch target ball shall be placed in front of the camera. The video shall be recorded in color on DVD format. Sufficient light shall be provided to show detail. Camera speed shall not exceed 3 feet per second. Camera shall have a swivel head capable of looking up each service connection. A copy of the video tape and a written TV Inspection Report shall be furnished to the Engineer. Any sections of sewer pipe not meeting specifications or exhibiting defects shall, at the Contractor’s expense, be corrected to meet specification. Repaired sections shall be re-televised. All repairs must be completed before acceptance of the project.

B. The sanitary sewer lines constructed as part of the project will also be video inspected near the end of the one year warranty period to determine if any defects exist in the system. The warranty video inspection will be conducted during a season of high groundwater as close to the end of the warranty period as possible. The warranty period
will continue to be in effect, regardless of duration, until all video recordings are received and approved. All defects in the system will be corrected at the Contractor’s expense.

**PART 4 SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Payment for Gravity Sewer Pipe & Fittings will be made on a lineal foot basis for each size, backfill class, for depths less than twelve (12) feet, and for depths greater than twelve (12) feet, at the unit prices stated on the Bid Form. Payment shall include compensation for trench excavation, shoring and bracing, pipe zone, pipe, connection to existing, backfill, anchors, fitting, transition couplings, appurtenances, testing, video inspection and all related work. Measurement will be made along the pipe centerline.

END OF SECTION
SECTION 02535 – MANHOLES & APPURTENANCES

PART 1  GENERAL

1.01  SUMMARY

A. This Section covers manholes, frames, covers, adapters, and other manhole appurtenances not specifically paid for in other sections, used in the gravity storm sewer conveyance system. See Standard Detail Drawings.

B. This Section covers manhole(s), frames, covers, adapters and other manhole appurtenances not specifically paid for in other sections.

C. All manholes, frames and covers supplied under this contract shall be from the same manufacturer.

PART 2  PRODUCTS

2.01  MATERIALS

A. Manholes

1. Manhole riser sections shall be pre-cast reinforced concrete with a minimum wall thickness of 6 inches, conforming to ASTM C 478. Concrete used in forming the sections shall have a minimum compressive strength of 4000 psi at 28 days. Reinforcing steel shall be Grade 60.

2. New manholes shall have precast reinforced concrete bases with shelves, channels and slopes as specified. Precast bases shall have same wall thickness and reinforcement as riser sections.

3. Joints between manhole sections as well as base sections shall be tongue and groove with an o-ring gasket or approved equal conforming to ASTM C-443. Preformed gaskets shall be Ram-Nek, Kent-Seal No. 2, or approved equal.

4. Manholes shall have yard permeability tests passing ASTM C497-03 prior to delivery. Manhole steps shall be plastic with ½” grade 60 steel reinforcing bars encapsulated with injection molded copolymer polypropylene with serrated surfaces.

5. Manholes shall be 60” Type 1 Manhole or approved equal.

B. Frames and Covers

1. All frames and covers shall be heavy duty, gray cast iron designed for H20 traffic loading. Metal used in the castings shall conform to ASTM A48 Class 30. All castings shall be manufactured true to pattern, uniform in quality, free from blowholes, shrinkage, distortion or other defects. Component parts shall fit together in a satisfactory manner and shall have continuously machined bearing surfaces to prevent rocking and rattling. Castings shall be smooth and well cleaned by shotblasting at the factory.

2. Frames and covers shall have skid resistant surface of raised knobs or indentations. Cover shall have the letter “S” cast into it. Non-watertight lids shall have two vent holes.
a. Storm drain covers shall have the letter “S” or word “Storm” cast into it.

3. Frames and covers shall be manufactured in accordance with the dimensions shown in the Standard Detail Drawings; Olympic Foundry, or approved equal.

C. Manhole Connections

1. Connections to precast manhole sections shall be accurately core-drilled and shall utilize a properly sized flexible rubber boot providing a watertight seal. Adapter shall be factory tested for watertightness up to 10.8 psi. Kor-N-Seal as manufactured by NPC, Inc. or approved equal.

2. Connections to cast-in-place concrete shall be made with a rubber waterstop grouting ring. Ring shall clamp to pipe with stainless steel clamp and have waterstop ribs. Waterstop Grouting Ring by Press-Seal Gasket Corp., or approved equal.

3. Connections to plastic manholes shall be made using appropriately sized flexible couplings and connecting to preformed pipe stub-outs, provided that stub-outs are not damaged.

D. Grout

1. Non-Shrink Grout. Grout shall be Sika 212, Euco N-S, Five Star, or approved equal nonmetallic cementitious commercial grout exhibiting zero shrinkage per ASTM C827. Grout shall not be amended with cement or sand and shall not be reconditioned with water after initial mixing. Nonshrink grout shall be placed and packed only with the use of an approved commercial bonding agent. Unused grout shall be discarded after 20 minutes.

E. Coating

1. Where specified on plans manholes shall be coated with a corrosion resistant epoxy. Coating shall be solvent free epoxy series Plastic 4500 or approved equal.

PART 3 EXECUTION

3.01 MANHOLE INSTALLATION

A. Prepare native soil and place and compact the crushed rock base to 95% maximum dry density as shown in the Standard Detail Drawings. Backfill material around manholes shall be as specified for trenches in Section 02320.

B. Concrete base shall be carefully placed on the prepared bedding so as to be fully and uniformly supported at true grade and alignment.

C. Pipe penetrations shall be core drilled to the appropriate size for each pipe entering or exiting the manhole. Jackhammering will not be allowed. Install appropriately sized KOR-N-SEAL boot on each pipe and apply non-shrink grout to remainder of wall penetration to provide positive seal. Non-shrink grout shall be as specified.

D. Install transition couplings, per Section 02530, within 2 feet of the outside wall of manholes on all pipes; or, a pipe bell shall be located a minimum of 1 foot to a maximum of 2 feet from the outside wall of manholes.
E. All flow channels within precast bases shall be constructed of non-shrink grout with a minimum depth of three-fourths (¾) the contributing pipe diameter. Inverts shall be true to line and grade with flow lines having a minimum drop of 0.1 feet from inlet to outlet (0.2 feet for 90 degree flow direction changes) or as shown on the Contract Drawings. Sides of channels shall be troweled smooth to prevent solids deposition. Ledges or benches shall be sloped towards channel to drain. Provide fine broom finish on ledges.

F. Clean tongue and grooves of base and wall sections, prime and apply joint sealer prior to setting in place. Ensure that joint has fully seated. Use approved flexible joint sealant and same manufacturer’s primer. The height of the lowest wall section shall be at least three (3) times the inside diameter of the largest sewer pipe entering the manhole and in no case less than 2-feet. Wall sections shall be plumb vertical.

G. Use eccentric cone top section for manholes greater than 6-feet deep. Use extension rings in accordance with the standard detail.

H. Frame and covers shall be installed so that the cover is exposed and flush with the existing surface. In no case will pavement be raised or lowered to meet the grade of installed manhole frames and covers. Where manholes are installed in sloping areas, the grade of the slope shall intersect the top rim of the cover on the uphill side. Manhole frame shall be sealed to the concrete manhole section with a bed of non-shrink grout on either side of bead of flexible joint sealant. In addition, the frame and cover shall be grouted to the outside of the concrete manhole section.

I. Manhole installations with tilted or otherwise defective bases, wall sections which are not plumb, covers which do not match existing grade properly, or are otherwise not in specification compliance shall be removed by the Contractor and replaced until acceptable.

J. Where indicated on plans manholes shall be sealed and bolted.

3.02 BENCH AND CHANNEL EXISTING MANHOLE

A. Modify or reconstruct manhole bases as required by hand forming channels with non-shrink grout to provide smooth flow surfaces from all inlets to the outlet. Non-shrink grout shall be as specified.

B. All flow channels shall be constructed with a minimum depth of three-fourths (¾) the contributing pipe diameter. Inverts shall be true to line and grade with flow lines having a minimum drop of 0.2 feet from inlet to outlet.

C. Shape flow channels to conform to connecting pipe surfaces. Ledges or benches shall be sloped towards channel to drain.

D. Remove all rough sections or sharp edges that might obstruct flow or cause snags.

E. Form base channels in conformance with the standard detail drawings.

3.03 NEW MANHOLES ON EXISTING SEWER MAINS

A. New manholes constructed along existing sewer mains shall, where feasible, utilize precast manhole bases as defined in Paragraph 2.01 A. Existing sewer mains shall be neatly cut or snapped approximately 12 to 18 inches outside the limits of the new manhole base. Pipe stubs, properly cut to length, shall be placed in properly sized cored
penetrations and joined to existing sewer mains using appropriate transition couplings as defined in Section 02530.

B. In situations where it is not feasible or practical to cut in new pre-cast manhole bases on existing sewer mains, cast-in-place bases will be allowed. Contractor shall notify Engineer of conditions warranting cast-in-place bases.

PART 4  SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Standard Manholes installed at all depths shall be made on a unit price basis per each, at the price stated on the Bid Form. Payment will include all materials and labor required for complete installation, including excavation and backfill around manholes, all precast components, grouting and shaping of base channels, pipe adapters, testing, temporary hard surfacing, and all else related to this item not paid under other sections.

B. Payment for Channeling, Benching and Modification of existing and/or new manhole bases will be made on a unit price bases per each, at the price stated on the Bid Form. Payment will include all materials, labor and equipment required for complete modification of the manhole base including all penetration coring, cleaning, preparation for cementitious grout all as required for a complete manhole base modification.

C. Connection of existing piping to new manholes shall be considered incidental to the work. No additional payment will be allowed.

END OF SECTION
SECTION 02630 – STORM DRAIN PIPING & FITTINGS

PART 1  GENERAL

1.01 SUMMARY

A. This item shall include furnishing and installing of the storm drain piping and fittings as required for the existing culvert replacement as identified on the Plans.

B. The Contractor shall provide manufacturer’s certifications, including test results for all piping, fittings and appurtenances supplied. All submittals shall be in conformance with the requirements of Section 01300.

C. All work shall conform to the latest version of the Oregon Standard Specifications (OSS) Part 00400, except as specified herein and shown on the Plans.

PART 2  PRODUCTS

2.01 MATERIALS

A. All pipe, fittings and appurtenances shall be new and unused.

B. PVC Pipe and fittings for storm drain piping shall conform to Class 12454-B, as defined in ASTM D1784. Pipe and fittings shall meet the requirements of ASTM D-3034 for 4” – 15” pipe SDR 35 and ASTM F679 for 18” – 36” pipe SDR 18. Neoprene gaskets with push on joints shall conform to ASTM F477.

1. All fittings and accessories shall be as manufactured and furnished by the pipe supplier or an approved equal and shall have bell and spigot configurations compatible with that of the pipe. Fittings and accessories shall have the same requirements as the pipe.

C. HDPE Storm Drain Pipe 12” through 48” diameter

1. Black PE materials used for the manufacture of polyethylene pipe and fittings shall be PE 4710 high density polyethylene meeting ASTM D 3350 cell classification 445574C (formerly PE 3408 meeting 345464C per ASTM D3350-02) and shall be Listed in the name of the pipe and fitting Manufacturer in PPI (Plastics Pipe Institute) TR-4 with a standard grade HDB rating of 1600 psi at 73°F. Color material, when used, shall be the same except for meeting ASTM D 3350 cell classification 445574E.

2. Pipe shall be DR11, Pressure Class 200 minimum, IPS Size, and shall be manufactured to the requirements of ASTM F714 and AWWA C906-99 (IPS) and shall be of standard pipe lengths (40 or 50 foot).

3. HDPE pipe shall be DriscoPlex 4100 IPS HDPE pipe; Isco industries or approved equal.

4. Pipe shall be provided with a continuous mark made of durable printing containing the following:

   a. Name and/or trademark of pipe manufacture, nominal pipe size and dimension ratio.
b. The manufacturing standard reference ASTM F714 and polyethylene grade per ASTM D3350.

D. Concrete shall conform to Oregon Standard Specifications Section 00440, Commercial Grade Concrete. Compressive field strength shall not be less than 3,000 psi at 28 days. Maximum aggregate size shall be 1½-inches. Slump shall be between 2 and 4 inches.

E. Non-Shrink Grout. Grout shall be Sika 212, Euco N-S, Five Star, or approved equal nonmetallic cementitious commercial grout exhibiting zero shrinkage per ASTM C827. Grout shall not be amended with cement or sand and shall not be reconditioned with water after initial mixing. Nonshrink grout shall be placed and packed only with the use of an approved commercial bonding agent. Unused grout shall be discarded after 20 minutes.

PART 3 EXECUTION

3.01 PIPE INSTALLATION

A. All pipe and fittings shall be installed in accordance with the manufacturer’s recommendations and APWA standards.

B. Remove from job site material, which in the judgment of the Engineer is damaged, not as specified, or otherwise rejected. Payment will not be made for damaged or rejected materials, their removal, or for repairs to such materials.

C. Preparation of Trench – Excavate and prepare trench for pipe laying to the lines and grades as specified and shown on the Plans. Place any required foundation stabilization and compact pipe bedding prior to laying pipe. Stabilize trench as required and comply with OSHA safety provisions.

D. Place and compact pipe bedding material before placing pipe in the trench. When applicable, dig depression for pipe bells to provide uniform bearing along the entire pipe length. Thoroughly compact bedding material to prevent future bellies.

E. Install to lines and grades shown on the Plans. Maximum deviation shall not exceed 0.05 feet vertically.

F. Prior to lowering pipe into the trench, the Engineer or City representative will check for damage to the pipe. The Contractor shall repair or replace, as directed, all damaged or flawed pipe prior to installation.

G. Thoroughly clean inside the pipe before laying. Prevent foreign material from entering the pipe while it is being placed in the trench. Remove all foreign material from the inside of the pipe and joint before the next pipe is placed. Keep debris, tools, rags or other materials out of the pipes at all times.

H. Lay pipe with bell ends facing the direction of laying. For lines on an appreciable slope, face bells up-grade unless otherwise directed by the Engineer. Thoroughly clean the ends of the pipe to remove all foreign matter from the pipe joint. Lubricate the bell and spigot ends with approved pipe lubricant, as recommended by the manufacturer.

I. Care must be taken to ensure the pipe is not moved and the side support fill is not disturbed when moving sheeting or trench boxes.

J. Place materials in the pipe zone in layers not greater than 6 inches thick and in a manner that equalizes the pressure on the pipe and minimizes stress. As required under the
haunches of pipe and areas not accessible to mechanical tampers or to testing, compact with hand methods to ensure thorough contact between the material and the pipe. Before placing the pipe zone material, condition, aerate, or wet the material so that the moisture content of each layer is within minus 4% to plus 2% of optimum moisture content.

K. Provide proper Backfill Class material as required. Backfill the trench above the pipe zone in successive lifts. Do not allow the backfill to free-fall into the trench until at least 3 feet of cover is provided over the top of the pipe. Modify the compaction as necessary to protect the pipe. Compact each lift to not less than 95% of the maximum dry density.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Storm Drain Piping shall be made on a lineal foot bases for the amount as stated on the Bid Form for each size, type and backfill class. Measurement and Payment for this item shall be based on the horizontal length.

B. Payment for fittings, including but not limited to Tees, Elbows, Couplings, Adapters and Sleeves shall be made on a unit price basis for each size and type of fitting installed for the corresponding unit price as stated on the Bid Form. No separate or additional payment will be made for nuts, bolts, washers and other fitting related hardware or supplies. Payment for fittings shall include compensation for connection to existing storm drain lines.

C. Payment for connection to existing storm drain manholes shall be made on a unit price bases per each regardless of size, depth or backfill material at the price as stated on the Bid Form. Payment shall include compensation for all materials, equipment and labor for a complete water-tight connection including, but not limited to: coring or jack hammering, flexible rubber boot or water stop ring, transition coupling and appurtenances for a complete installation and connection.

D. Payment for connection to new catch basins and area drains shall be included within the unit price for catch basins and area drains and all associated appurtenance items. Price shall include compensation for all materials, equipment and labor for a complete water-tight connection including, but not limited to; coring or jack hammering, flexible rubber boot or water stop ring, transition coupling and appurtenances for a complete installation and connection.

END OF SECTION
PART 1  GENERAL

1.01 SUMMARY

A. This item shall include direction, specifications, and information regarding the construction, reconstruction, and/or the planned mitigation of wetlands as indicated on the plans.

B. The Contractor shall not disturb, damage, or fill wetland areas other than as indicated on the plans. If additional wetlands are disturbed or impacted, the Contractor shall be responsible for the coordination with the regulatory agencies and the necessary steps to mitigate the impacts.

C. All wetland construction, restoration, and mitigation shall meet the requirements of the US Army Corps of Engineers, The Oregon Division of State Lands, the issued Removal Fill Permit and these specifications.

D. There are several wetland areas that will be impacted by this project as identified in the 2017 Wetland Delineation Report for the Sewer Main and Lift Station Project by Pacific Habitat Services, Inc. The plans indicate these areas and the plan for addressing these impacts is provided within this section.

1.02 RELATED SECTIONS

A. Section 02900 Site Cleanup and Landscape Restoration

B. Section 02370 Erosion Control

C. Section 02270 Slope Protection

PART 2  PRODUCTS

2.01 MATERIALS- GENERAL

A. Reconstruction, restoration, and mitigation efforts required for impacted wetland areas will endeavor to utilize a “like for like” approach regarding materials.

B. When soils are impacted in wetland areas, the rich wetland soils (generally in the top 12-24” inches) will be separated and stockpiled to be used as surface soils in the restoration, reconstruction, or mitigation efforts.

C. Vegetation and plantings should be reestablished using native, existing, or approved varieties.

PART 3  EXECUTION

3.01 Wetland Construction, Reconstruction, and Mitigation

A. All soils disturbed or removed from identified wetland areas will be separated, stockpiled, and reused for the restoration activities.
B. Where practical and possible, plants, bushes, and other vegetation should be removed and reused in the restoration efforts.

C. The Contractor shall take care to not impact other wetland areas outside of those shown on the plans and discussed within this section. If other areas are impacted, mitigation and corrective actions, and their associated costs, are the sole responsibility of the Contractor.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. No payment shall be made for this section.
SECTION 02720 – AGGREGATE BASE

PART 1 GENERAL

1.01 SUMMARY

A. This section includes all work necessary for furnishing, placing, compacting and grading aggregate base/Gravel Shoulder on the prepared surface to the lines, grades, thicknesses and cross sections shown on the Plans or where indicated.

1.02 REFERENCES

A. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort


1.03 SUBMITTALS

A. Contractor shall furnish sample of proposed material for visual inspection by Engineer prior to importing to site.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aggregate leveling course and shoulder rock shall be 1” – 0 or ¾” – 0 (19.0mm – 0) angular crushed rock conforming to OSS Section 00640.

B. Aggregate sub-base shall be 1½” – 0 (37.5mm – 0) angular crushed rock. Use clean, hard, durable aggregates, reasonably well-graded from the maximum size to dust.

C. Aggregate leveling course and sub-base shall conform to OSS Section 00640 or shall be obtained from a source pre-approved by the Owner.

D. Geo-Fabrics

1. Separation liner shall be provided beneath aggregate base and native bearing soil and shall have a mean average roll value (MARV) strength properties meeting the requirements of AASHTO M 288-2000 Class 2 geotextile (geotextile for separation) with a permittivity greater than 0.05 sec.\(^{-1}\) and an apparent opening size less than 0.6 mm.

2. Specification sheet to be provided on selected geotextiles for approval prior to order and delivery to site.

PART 3 EXECUTION

3.01 WORKMANSHIP

A. Sequencing and Scheduling – Notify Owner and Engineer 48-hours prior to placement of aggregate base to permit inspection.

B. Excavate to proper sub-grade elevations as shown on the Plans or as necessary to provide required thickness of aggregate base.
C. Preparation of sub-grade – Provide a firm sub-grade surface on which aggregate base is to be placed. Scarify sub-grade surface to provide bonding for aggregate base.
   
   1. Sub-grade Overexcavation & Replacement – Remove and dispose of any unstable or unsuitable materials as directed by the Engineer. Replace any excavated materials with successive lifts of aggregate sub-base or other materials as directed by the Engineer. Grade and compact, as required, to provide a smooth surface that conforms to the surrounding grades.
   
   2. Place geo-fabric separation liner over areas where over excavation is required to provide a bridge over soft native bearing soils. Liner shall be placed smooth and without wrinkles or folds in the direction of filling with a minimum 2 foot overlap between adjacent rolls.
   
   3. Sub-grade Compaction – compact exposed sub-grade.

D. Mixing – Mix to provide a homogeneous mixture of unsegregated and uniformly dispersed materials. Add water or aerate, as necessary, during mixing to achieve optimum moisture content ±2% during placement.

E. Placement
   
   1. When, in the judgment of the Engineer, the weather is such that satisfactory results cannot be achieved, operations shall be suspended. Owner shall not be liable for damages or claims of any kind or description due to the suspension of operations by the Engineer.
   
   2. Aggregate base materials shall be deposited on the sub-grade at a uniform quantity per linear foot so that the Contractor will not resort to spotting, picking up, or otherwise shifting material. Segregation of aggregates shall be avoided and material so spread shall be free of pockets of coarse or fine materials.
   
   3. Place aggregate base materials such that when compacted and finish graded it will conform to the grades and sections shown on the Plans. Aggregate base materials shall be placed in maximum lifts of 6-inches, or as approved by the Engineer. Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.
   
   4. Place shoulder rock materials such that when compacted and finish graded it will match final pavement grade. Should rock materials should be 1 foot wide and depth as needed or as approved by the Engineer.

F. Compacting and Shaping
   
   1. Aggregate base materials shall be compacted by self propelled, smooth drum, static or vibratory rollers capable of achieving the specified compaction.
   
   2. Shape and maintain the surface of each layer of aggregate base during compaction operations such the surface of each layer is parallel to the established grade and cross section for the finished surface within 0.05 foot.
   
   3. Aggregate base materials shall be compacted to 95% maximum dry density as determined by the ASTM D698 test method.

G. Comply with Section 02321, Compaction Testing.
PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Measurement and payment for Compacted Aggregate Leveling Course 3/4"-0 to 1-1/2"-0 shall be on a cubic yard basis at the amount stated on the Bid Form for Foundation Stabilization. Payment shall include compensation for materials, hauling, placing, compacting, testing and all other incidental work.

END OF SECTION
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SECTION 02730 – GRAVEL SURFACING

PART 1  GENERAL

1.01 SUMMARY

A. The work in this section includes all work necessary to remove, replace, construct, compact and grade gravel surfacing on existing gravel roads and surfaces as indicated, whether directly or indirectly damaged or altered by any of the operations incidental to this project. All damaged gravel surfacing shall be replaced to the extents specified herein.

PART 2  PRODUCTS

2.01 MATERIALS

A. All gravel surfacing material shall be ¾-inch minus, clean, well-graded, angular, crushed rock/gravel from an approved quarry or river source, and free from organic matter.

PART 3  EXECUTION

3.01 WORKMANSHIP

A. Sequencing and Scheduling – Notify Engineer 48-hours prior to placement of gravel surfacing to permit inspection.

B. Preparation of Subgrade – ensure that all surfaces and materials on which gravel surfacing is to be placed are sound and compacted. Grade and compact, as required, to smooth surface and remove potholes. Scarify existing surface to loosen material to provide bonding for new material.

C. Mixing – Mix to provide a homogeneous mixture of unsegregated and uniformly dispersed materials which will compact to not less than 95% relative compaction. Add water or aerate, as necessary, during mixing to achieve optimum moisture content ±2% during placement.

D. Placement

1. When, in the judgment of the Engineer, the weather is such that satisfactory results cannot be achieved, gravel surfacing operations shall be suspended. Owner shall not be liable for damages or claims of any kind or description due to the suspension of operations by the Engineer.

2. Aggregate shall be deposited on the subgrade at a uniform quantity per linear foot so that the Contractor will not resort to spotting, picking up, or otherwise shifting of gravel surfacing material. Segregation of aggregates shall be avoided and material so spread shall be free of pockets of coarse or fine materials.

3. Depth of new gravel surfacing shall be equivalent to the depth of material on existing streets and private driveways, with a minimum required depth of 6-inches. Gravel shall be placed in maximum lifts of 3-inches, or as approved by the Engineer. Final depth of gravel surfacing shall be determined by the Engineer. Depths less than 6-inches may be allowed in areas with minimal gravel surfacing.
4. All damaged gravel surfacing shall be replaced. The minimum width of gravel surfacing required to be replaced shall be the trench width plus 2-feet. The Owner may elect to have the entire width of existing surfacing replaced.

E. Comply with Section 02321, Compaction Testing.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Measurement and payment for Gravel Surfacing shall be on a square foot basis and shall include the specified material, installation, removal and disposal of existing gravel. Payment will be made only for gravel surfacing replaced within the specified project limits. Replacement of gravel surfacing required due to damage or alteration of existing gravel surfaces due to the Contractor’s operations shall be at the sole expense of the Contractor. No additional compensation will be allowed.

END OF SECTION
SECTION 02740 – ASPHALT CONCRETE PAVEMENT

PART 1 GENERAL

1.01 SUMMARY

A. This section includes furnishing all materials, labor and equipment necessary to construct asphalt concrete pavement to the lines, grades and cross sections shown or established, including one or more courses and overlays. Work shall be performed in conformance with any applicable State, County or City Standards.

PART 2 PRODUCTS

2.01 DEFINITIONS

A. Hot Mixed Asphalt Concrete (HMAC) – Asphalt concrete is a hot mix of asphalthic cement; well graded, high quality aggregate; mineral filler and additives, as required; plant mixed into a uniformly coated mass, hot laid in on a prepared foundation, and compacted to a specified density.


C. ASTM D946 - Standard Specifications for Penetration-Graded Asphalt Cement for use in Pavement Construction; 2009. ASTM D946-09a

2.02 MATERIALS

A. Unless otherwise specified herein, types, grades, quality and proportions of materials shall conform to specified and/or applicable sections of the current Oregon Standard Specifications.

B. HMAC shall be Level 3 HMAC, \( \frac{3}{8} \)-inch Dense Graded Mix in accordance with OSS Section 00745.

C. Asphalt Tack Coat shall consist of CSS-1 or CSS-1h emulsified asphalt (EA) tack coat conforming to OSS 00730.

D. Base Aggregate shall be as specified in Section 02720 of these specifications.

E. Joint Sealant:

1. Joint seal shall meet the test requirements of ASTM D244.

2. Joint seal material shall be CRS-1 or CRS-2 and shall meet the requirements of OSS; Section 02710 for Cationic Emulsified Rapid Setting Asphalt

F. When required to by the contract Contractor shall add HMAC Reinforcing Fibers to the HMAC Mix as described in this section. See HMAC Reinforcing Fibers section of the Technical Specifications, Section 02741.

PART 3 EXECUTION

3.01 WORKMANSHIP
A. Unless otherwise specified herein, HMAC shall be mixed, processed, hauled, laid, compacted and finished in accordance with OSS Section 00745.

B. Notify the Engineer at least 48-hours prior to placement of base aggregate and asphalt concrete pavement to permit inspection.

C. When, in the judgment of the Engineer, the weather is such that satisfactory results cannot be achieved asphalt concrete paving operations shall be suspended. Owner shall not be liable for damages or claims of any kind or description due to the suspension of operations by the Engineer. HMAC shall not be placed when the ambient temperature is below 40º F, or surface is wet or frozen.

D. Adhere to all applicable State and/or OSHA regulations pertaining to road closure, traffic control, and other related safety precautions.

E. To provide for the convenience and safety of the traveling public, pavement replacement shall be performed immediately following the completion of backfilling operations. In the event that pavement replacement cannot be performed as such, the Contractor shall maintain the trench backfill on a daily basis, as directed, until pavement replacement has been completed.

F. Subgrade and aggregate base shall be prepared, compacted and finished in accordance with Section 02720.

G. Pavement Sawcutting
   1. Utility trenches in existing pavement areas shall be sawcut immediately prior to repaving. Sawcuts shall be made a minimum of 12-inches outside the limits of the trench, or to the outer extents of pavement damaged as a result of the Contractor’s operations, whichever is greater.

H. Tack Coat Asphalt
   1. Contact surfaces of manholes, catch basins, gutters and existing pavements shall be treated with a layer of tack coat asphalt. Do not place on wet surfaces.
   2. Joints between existing and new AC pavement shall be filled with tack coat asphalt.
   3. Apply tack coat asphalt with a pressure distributor capable of uniformly applying the emulsified asphalt at even heat on variable surface widths up to 16-feet, at readily determined and controlled rates from 0.05 to 0.20 gallons per square yard, and with uniform pressure. Pressure distributor shall include a tachometer, pressure gages, accurate volume measuring devices and a thermometer for measuring temperature of tank contents. Pressure distributor shall be equipped with a positive power asphalt pump and full circulation spray bars adjustable both laterally and vertically. Set bar height for triple lap coverage.
   4. Minimum surface temperature at the time of placement of tack coat asphalt shall not be less than 50º F.
   5. Tack coat shall only be applied to clean dry surfaces. All loose material should be removed by sweeping, flushing with water or other approved methods.
   6. Apply tack coat asphalt at the following rates for the indicated surfaces.
<table>
<thead>
<tr>
<th>Surface</th>
<th>Application Rate (gallons / yd²)</th>
<th>Undiluted</th>
<th>Diluted 1:1 with Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>New HMAC</td>
<td>0.05 – 0.07</td>
<td>0.10 – 0.13</td>
<td></td>
</tr>
<tr>
<td>Oxidized HMAC</td>
<td>0.07 – 0.10</td>
<td>0.13 – 0.20</td>
<td></td>
</tr>
<tr>
<td>Milled HMAC</td>
<td>0.10 – 0.13</td>
<td>0.20+</td>
<td></td>
</tr>
</tbody>
</table>

7. Tack coat asphalt shall be at a temperature between 140º F and 185º F as recommended by the manufacturer at the time of application.

8. Do not place HMAC on the tack coat until the asphalt separates from the water, but before it loses its tackiness.

I. Asphalt Concrete Pavement

1. HMAC shall be a minimum of 250º F at the time of placement.
2. Storage of HMAC in silos shall not be permitted.
3. Control of line and grade shall be manual.
4. HMAC shall be covered during hauling if rain or cold air temperatures are encountered any time between loading and placement. HMAC will be rejected if any of the following is observed: mix falls below minimum specified temperature; slumping or separating; solidifying or crusting; absorbing moisture. Rejected loads shall be disposed of at the Contractor’s expense.
5. Deposit HMAC from the hauling vehicles so segregation is prevented. HMAC shall not be windrowed.

J. Placement

1. HMAC should be placed using a self-contained, self-propelled paver supported on tracks or wheels that do not contact the mix being placed.
2. When leveling irregular surfaces and raising low areas, do not exceed 2-inches actual compacted thickness on any one lift.
3. Place the mix in the number of lifts and courses, and to the compacted thickness for each lift and course as shown on the Plans. Limit the minimum lift thickness to twice the maximum aggregate size in the mix.
4. The compacted depth of new asphalt concrete pavement on public streets shall be 4-inches, minimum. Asphalt concrete paving for utility trench patches shall be 4-inches, minimum, or shall match the existing paving, whichever is greater. Asphalt concrete overlays on public streets shall have a minimum thickness of 4-inches. On non-public roads or driveways, match existing thickness, with a minimum thickness of 2-inches. Asphalt concrete pavement in excess of 2-inches thick shall be constructed in multiple lifts of approximately equal thickness. The maximum compacted thickness of any individual lift shall not exceed 2-inches.
5. Pavement shall be placed, shaped, compacted and finished to the grades and cross sections shown on the Plans or established. Taper new overlays at limits to match existing asphalt pavement.
6. HMAC shall be compacted using self-propelled steel wheeled static rollers, vibratory rollers, or pneumatic tired rollers capable of achieving the minimum...
compaction specified. If vibratory rollers are used, they should be specifically designed for compaction of HMAC, have adjustable amplitude and frequency, and be capable of at least 2000 vibrations per minute. Finish rolling should be performed by a static roller or a vibratory roller in the static mode.

7. Asphalt concrete pavement shall be compacted to a minimum of 92% relative compaction with the theoretical maximum density determined by AASHTO T-209. Testing shall be performed at random locations using a nuclear gauge operated in the back-scanctter mode. At least one density test shall be performed every 1000 lineal feet on each spread or a minimum of one test each day of production. At least one density test will be required.

8. No traffic shall come in contact with any newly paved surface until surface has cooled and set sufficiently to prevent marking. The Contractor is responsible for traffic control.

9. Test the top surfaces with a 12-foot long straight edge in conformance with Section 00745.70 of OSS. The finish grade shall have a smooth uniform surface for storm drainage with no low spots that would collect water, causing puddling.

10. Surface of the asphalt concrete after compaction shall be smooth and true to a tolerance of 0.02 foot of the established cross section and grade, conforming to Section 00745.70 of OSS. Any mixture that become loose or broken, mixed with dirt or is in any way defective, shall be removed and replaced with fresh hot mixture which, when compacted, shall conform to the surrounding area. There shall be no sign of roller marks. All cost in correcting defective surfaces shall be borne by the Contractor.

   a. Tolerances

      1) Flatness: Maximum variation of 1/4 inch measured with a 10-foot straight edge

      2) Variation from Trued Elevation: Within 1/2 inch.

   b. Protection

      1) Immediately after placement protect pavement form mechanical injury for 7 days or until surface temperature is less than 140 degrees.

      2) No traffic shall come in contact with any newly paved surface until surface has cooled and set sufficiently to prevent marking. The Contractor is responsible for this traffic control.

      3) After completion of paving, the Contractor shall remove from the site all debris resulting from the Contractor's operation.

      4) All costs incurred in the repair of deficiencies or damages shall be borne by the Contractor, and no additional compensation shall be due to the Contractor.

K. Warranty
1. Contractor shall maintain all asphalt concrete paved areas and shall furnish all required materials and workmanship at no additional cost to the Owner for a period of one year following the Owner's acceptance of the complete project.

2. If any newly paved asphalt concrete surfaces settles, cracks, breaks, or becomes otherwise defective within the warranty period as described herein, then the deficiencies or damages in surfacing shall be immediately repaired by the Contractor upon request and in a manner approved by the Engineer.

3. All costs incurred in the repair of deficiencies or damages shall be borne by the Contractor, with no additional compensation allowed.

**PART 4 \ SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

   A. Payment for Asphalt Concrete Pavement-Level 3 shall be paid for at the per ton amount as stated on the Bid form. Payment shall include compensation for all work necessary to prepare, lay, compact and otherwise fully complete the new asphalt concrete pavement surface. There will be no separate measurement of bituminous cements or additives contained in the mixture or used otherwise in the work. Payment will be made only for material incorporated into the specified limits.

   B. The cost for sawcutting existing pavement adjacent to new utility trenches shall be considered incidental to the work. No additional compensation will be allowed for this item.

**END OF SECTION**
SECTION 02760 – PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes all materials and workmanship for durable permanent pavement striping and pavement markings.

1.02 DEFINITIONS


B. ODOT Qualified Products List (QPL) – The Qualified Products List published every six months by the Oregon Department of Transportation, Construction Section.

PART 2 PRODUCTS

2.01 MATERIALS

A. All markings shall be white and shall be from the ODOT QPL. Pavement markings for this project shall be painted per ODOT Standard Method ‘F’ or extruded per ODOT Standard Method ‘B” or approved equal.

PART 3 EXECUTION

3.01 DURABLE PAVEMENT STRIPING APPLICATION

A. Apply striping to the lines and locations shown on the Plans or as directed.

B. Lay out a continuous guideline for each line and receive approval from the Engineer prior to striping.

C. Apply striping material only when the surface is sufficiently dry, clean and free of contaminants such as surface oils. Some striping materials require the asphalt to cure for several weeks prior to placement.

3.02 FINISHING AND CLEANUP

A. Protect applied markings from traffic until sufficiently dry to prevent damage or tracking by normal traffic movements. At a minimum, place cones or tubular markers next to all pavement markings, and place barricades at all areas where cross traffic is anticipated.

B. Remove or repair all unacceptable work and dispose of at the Contractor’s expense. Repair or replace unacceptable work immediately if it causes a safety problem. The removed material becomes the property of the Contractor. If additional traffic control is required for removal of unacceptable material, provide it as directed and at no additional cost to the Owner.

C. Do not open up any work area to traffic that is not adequately striped and suitable for safe driving.
PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Painted Permanent Markings will be made on a unit price basis per lineal foot of Painted Permanent Pavement Striping in the amount as stated on the Bid Form. Payment will include all materials, labor and equipment required for layout and application of durable painted pavement parking stall and centerline striping as described herein and as shown on the plans. No separate payment will be allowed.

B. Payment for 12" wide white Thermoplastic Stop Bar will be made on a unit price basis per lineal foot as indicated on the Bid Form. Payment will include all materials, labor and equipment required for layout and installation of Thermoplastic Stop Bars as shown on the Plans and described herein. No separate payment will be allowed.

END OF SECTION
SECTION 02900 – LANDSCAPE RESTORATION AND CLEANUP

PART 1  GENERAL

1.01  SUMMARY

A.  This section covers the work necessary to reseed, restore and cleanup the site. Work shall include the removal of all construction equipment, rubbish, construction debris, and unused materials of any kind resulting from project activities.

B.  Site cleanup shall include the clean up of all pavement surfaces, whether new or existing within the limits of the project and replacement of pavement markings.

PART 2  PRODUCTS

2.01  RESEEDING MATERIALS

A.  Grass seed shall be from blue tag stock and from the latest crop available. Deliver each variety in standard containers labeled in accordance with Oregon State laws and U.S. Department of Agriculture rules and regulations under the Federal Seed Act. Provide with label showing seed variety, percentage of purity, germination, maximum weed content, date of test within nine months of date of delivery, and as set forth in the General Seed Certification Standard by the Oregon State University Certification Board. Mold or other evidence of container having been wet or otherwise damaged will be cause for rejection of each lot of seed. Grass seed may be delivered to the project as a mixture provided each variety of grass seed in the mixture is identified and labeled as specified.

B.  Where imported topsoil is required, provide natural, fertile, friable topsoil, representative of local productive soil, and 90% free of clay lumps or other foreign matter larger than 2-inches in diameter, not frozen or muddy, with pH 5.0 to 7.0, and not less than 3% humus as determined by loss of ignition of moisture-free samples dried at 100°C. Gravel portion (particles larger than 2 mm) shall not exceed 15% of total volume. Topsoil shall be free of quack grass, horsetail and other noxious vegetation and seed. Should such regenerative material be present in the soil, all resultant growth, both surface and root, shall be removed by the Contractor within 1-year of acceptance of the work at no expense to the Owner.

C.  Provide a lime compound of ground dolomitic limestone not less than 85% total carbonates and magnesium, ground so that 50% passes a number 100 sieve and 90% passes a number 20 sieve. Coarser material will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing the number 100 sieve.

D.  Furnish fertilizer in moisture-proof bags marked with weight and the manufacturer’s certified analysis of the contents showing the percentage for each ingredient. Furnish fertilizer in a dry condition free from lumps and caking, in granular or palletized form, of standard commercial grade conforming to all State and Federal regulations and to the standards of the Association of Official Agricultural Chemists.

E.  Provide all other materials required to accomplish the work specified.

PART 3  EXECUTION
3.01 WORKMANSHIP

A. Surface Dressing

1. Slopes, sidewalk areas, planting areas, easements and roadways shall be smoothed and dressed to the required cross section and grade by means of a grading machine insofar as it is possible to do without damaging the work or existing improvements, trees and shrubs. Supplement machine dressing by hand work as directed.

2. Upon completion of the cleaning and dressing, the project shall appear uniform in all respects. Grade all areas true to line and grade as shown or as approved. Where the existing planting is below sidewalk and curb, fill and dress the area to the walk regardless of limits shown. Wherever fill material is required in the planting area, make finished surface high enough to allow for final settlement.

B. Remove and dispose of all excavated or construction materials, equipment, and rubbish of all kinds resulting from the work. Where brush and trees beyond the limits of the project have been disturbed or damaged, remove and dispose of or restore same, as directed, at no expense to the Owner.

C. Clean all drainage facilities such as inlets, catch basins, culverts and open ditches of all excess material or debris resulting from the work, to the satisfaction of the Owner.

D. Clean all pavement surfaces, whether new or existing within the limits of the project. Clean existing improvements such as curbs, gutters, walls, sidewalks, castings for manholes, monuments, water gates, lamp poles, vaults, signs, and other similar installations as approved. Flush the street with a pressure type flusher as approved. Hand sweep or flush all sidewalks as directed.

E. Fused thermoplastic stop bar and pavement markings shall be installed following manufactures recommendations for installation. Pavement surface shall be free of dirt, grease, moisture or any other foreign material prior to the placement of striping and pavement markings.

F. Unless otherwise specified by Engineer, disturbed areas adjacent to roadways shall be restored with Gravel Surfacing as specified in Section 02340.

G. Restoring Planted Areas

1. Hand rake and drag all formerly grassed and/or planted areas leaving disturbed areas free from rocks, gravel, clay, or any other foreign material and ready, in all respects, for seeding. The finished surface shall conform to the original surface, be free draining and free from holes, rough spots, or other surface features detrimental to a seeded area.

2. Plant grass seed only at times when local weather and other conditions are favorable to the preparation of the soil and to the germination and growth of grass. Sow grassed areas evenly with a mechanical spreader at a rate of one pound per 300 square feet, roll with ctipacker to cover seed, and water with fine spray. Method of seeding may be varied as approved, however, responsibility to establish a smooth, uniformly grassed area will not be waived.
PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Landscape Restoration & Cleanup will be made on a lump sum basis at the price stated on the Bid Form. Payment shall include all materials and labor required to complete the work described herein.

END OF SECTION
## DIVISION 3- CONCRETE
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SECTION 03110 – STRUCTURAL CAST-IN-PLACE CONCRETE FORMS

PART 1  GENERAL

1.01 WORK INCLUDED
   A. Concrete formwork required for all project structural concrete.
   B. Formwork design, placement, proper securing and support, and removal.
   C. Coordination for various wall and slab penetration locations and sizes including sleeve positioning for casting in place.
   D. Positioning of anchor bolts, grating and vault lid frames, and other imbedded items.

1.02 RELATED SECTIONS
   A. Section 03300 – Cast-In-Place Concrete
   B. Section 03200 – Concrete Reinforcement
   C. Section 03150 – Concrete Accessories
   D. Hangers and Inserts for Mechanical and Electrical Work: Divisions 15 and 16

1.03 REFERENCES
   A. American Concrete Institute (ACI) 318, Chapter 6 – Formwork, Embedded Pipes, and Construction Joints.
   B. ACI 347R-88 – Guide to Formwork for Concrete.

1.04 QUALITY ASSURANCE
   A. Forms shall be constructed by laborers experienced in concrete formwork erection.
   B. Ensure that forms are smooth, vertically plumb or horizontally flat as applicable, and properly spaced to provide finished concrete structures as shown on the drawings.
   C. Resulting work which is not in conformance with applicable contract specifications shall be promptly removed and replaced.

1.05 DELIVERY, STORAGE AND HANDLING
   A. Protect form materials from damage that may affect finish appearance or form stability.
   B. Keep forms clean and free from deleterious materials.

1.06 PROJECT CONDITIONS
   A. Refer to drawings to estimate quantities and locations involved.
   B. All exposed edges shall be properly formed and chamfered where shown.
   C. Conduct required excavation and provide excavation support as necessary.
PART 2 PRODUCTS

2.01 FORM MATERIALS

A. Lumber Plank
   1. Species: Douglas Fir or Hemlock
   2. Casting Face Texture: Smooth
   3. Casting Face Appearance: No loose knots or knot holes; maximum knot size 1-1/2 inch and well scattered.
   4. Extent of Work: provide at footing. Flatwork perimeters, curbing, and pedestals, unless otherwise indicated.

D. Plywood Forms
   1. Material: APA B-B Plyform grade Plywood Class 1
   2. Thickness: As required by Concrete placement rate
   3. Extent of Work: Provide at all other Concrete Work

C. Steel

2.02 ACCESSORIES

A. Form Ties
   1. Manufacturer: Bowman, Burke, Dayton, JEF, or approved.
   2. Type: plastic cone as recommended by manufacturer for conditions of use.
   3. Break-back distance from concrete face: 1-inch
   4. Do not use wire ties and wood spacers

B. Form Release Agents
   1. Non-staining, VOC compliant, water-based form release compound. Should be opaque in color to aid in full coverage.
   2. W.R. Meadows "Duogard II", or approved equal.

C. Form Joint Caulking
   1. Manufacturer and Brand: Sonneborn Sonolac, Dap Acrylic Latex, or approved

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure that reinforcing steel is properly placed according the spacing and tolerances required, and that proper inspection has been conducted.
B. Ensure waterstops are installed as required when placed prior to formwork.

C. Review plans for wall and slab penetrations and imbedded items.

D. Remove debris and foreign matter from formwork. Clean form contact surfaces. Replace with new material when necessary or when directed.

E. Remove loose rust and foreign matter from reusable hardware prior to installation into formwork.

F. Re-use forms only when contact surfaces equal original use and forms have been adequately cleaned.

3.02 INSTALLATION

A. Comply with ACI 318 and ACI 347.

B. Carefully conform to the shapes, lines and dimensions of the drawings. Ensure that edges are chamfered where shown. Form any surface indentations shown on the Drawings.

C. Arrange to provide concrete cold joints as indicated on the drawings.

D. At forms for exposed concrete, fill form panel joints with form joint caulking compound, and strike compound flush with panel on face adjacent to exposed concrete, or cover joints with thin, smooth, plastic, pressure-sensitive tape.

E. At forms for exposed concrete, seal form ties against leakage with form joint caulking compound.

F. Make form joints tight to prevent leakage. Minimize the number of form joints used.

G. Ensure that formwork is properly supported, tied, and braced to prevent deflection and maintain shape (see allowable tolerances for formwork).
   1. Provide bracing as required to meet load requirements.
   2. Protect against undermining or settlement when placed on ground.
   3. Anchor as required to prevent upward or lateral formwork movement during concrete placement.

H. Provide access openings as required for cleaning and inspection of Forms and embedded Items prior to placing concrete. Locate where not exposed to view.

I. Provide openings and chasings of slabs and walls for Mechanical and Electrical Work. Sizes and locations are directed by Mechanical and Electrical Trades and Drawings.

J. Anchor Bolts: Set with templates to assure accurate bolt positioning

K. During concrete placement, in areas where formwork develops weakness, settlement, or distortion, stop concrete placement, remove placed concrete, and remove or strengthen formwork.

L. Reposition to true alignment prior to, during, and after Concrete placement, if necessary.
3.03 ALLOWABLE TOLERANCES FOR FORMWORK
   A. Variation from Plumb: 1/4 inch in 10 feet maximum
   B. Variation of Building Lines: 1/4 inch in any Bay or 20 feet maximum
   C. Variation in Cross-Sectional Dimensions: Minus 1/8 inch; plus 1/4 inch
   D. Variation in Surface Tolerance: 1/8 inch in any 10 feet measured with 10-foot straightedge.
   E. Maximum Deflection of Form facing between Supports: 0.00025 x Span
   F. Wall Locations: Accurately size and locate within 1/8 inch.

3.04 FORM TREATMENT
   A. All forms shall be adequately treated with form release agent to prevent concrete damage during form removal.
   B. Prior to each use: Apply form coating to contact surfaces in accordance with Manufacturer’s instructions. Conduct surface preparation in accordance with manufacturer’s instructions prior to coating forms.
   C. When treating previously set forms, carefully prevent coatings from covering reinforcing steel, waterstops, imbedded items, or existing concrete.
   D. Prevent coatings from collecting in puddles.

3.05 FORM REMOVAL
   A. Leave forms and shoring in place until concrete has attained sufficient strength to safely support own weight and imposed loads.
   B. Remove forms at time and in manner to insure safety of structure, and without concrete surface damage.
   C. At exposed concrete, form removal time shall be uniform to avoid color differences.
   D. Remove top forms from any sloping concrete surfaces as soon as concrete is self-supporting. Repair and finish, if necessary, and cure immediately.

3.06 CLEANING AND REPAIRING
   A. Including Work of other Trades, clean, repair, and touch-up, or replace when directed, products which have been soiled, discolored, or damaged by Work of this Section.
   B. Remove debris from Project Site upon Work completion, or sooner if directed.
PART 4  SPECIAL PROVISIONS

4.01  MEASUREMENT AND PAYMENT

A.  Cost for concrete formwork shall be included as a portion of the lump sum costs for the Control Building as stated in the Bid Form. No separate measurement for these quantities will occur.

B.  Cost for concrete formwork shall be included as a portion of the unit price costs for the Manholes as stated in the Bid Form. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 03152 – PREMOLDED EXPANSION JOINT FILLERS

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Premolded Expansion Joint Fillers.

1.02  REFERENCES

A. ASTM D 1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
B. ASTM D 1752
C. AASHTO M 213
D. Corps of Engineers: CRD-C 508
E. FS – Federal Specification

1.03  RELATED SECTIONS

A. Section 03300 – Cast-In-Place Concrete

1.04  QUALITY ASSURANCE

A. Manufacturer shall demonstrate five years (minimum) continuous, successful experience in production of items covered in this section.

1.05  DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in a clean dry area indoors in accordance with manufacturer’s instructions. Keep containers sealed until ready to use.

C. Protect materials during handling and installation to prevent damage or contamination.

PART 2  PRODUCTS

2.01  MATERIALS

A. Fiber Expansion Joint

1. Resilient, flexible, non-extruded, expansion-contraction joint filler. Cellular fibers securely bonded together, uniformly saturated with asphalt.

2. Compliance: ASTM D 1751; AASHTO M 213; FS HH-F-341 F, Type I.

3. Recovery when compressed to half width: 70% minimum

4. Use: exterior expansion joints in sidewalks, drives, and between adjoining structures.

B. Flexible Foam Expansion Joint


2. Compliance: ASTM D 5249; ASTM D1752 5.1-5.4.

3. Recovery: 99% minimum

4. Use: interior expansion joints.
PART 3  EXECUTION

3.01  INSTALLATION

A. Install in accordance with manufacturer’s instructions at locations shown on the drawings and as directed.

B. Position joint filler against forms, at interrupting objects, and against abutting structures before placing concrete.

C. Install joint filler ½-inch below concrete surface.

D. Seal with flexible joint sealant.

E. Protect from traffic or damage until sealant has fully cured.

PART 4  SPECIAL PROVISIONS

4.01  MEASUREMENT AND PAYMENT

A. Cost for expansion joint fillers shall be included as a portion of the unit price for the associated items as stated on the Bid Form. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 03200 – CONCRETE REINFORCEMENT

PART 1  GENERAL

1.01 SUMMARY

A. Section includes reinforcement for concrete including deformed steel bars, welded-wire-fabric, and fiber reinforcement.

B. Supply, detailed shop drawings, and reinforcing placement.

C. Provide reinforcing to the sizes and dimensions shown on the drawings and according to approved shop drawings for rebar placement.

1.02 RELATED SECTIONS

A. Section 03110 – Structural Cast-In-Place Concrete Forms

B. Section 03300 – Cast-In-Place Concrete

C. Hangers and Inserts for Mechanical and Electrical Work: Divisions 15 and 16

1.03 REFERENCES

   1. ASTM A 615 – Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   2. ASTM A 185 – Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
   3. ASTM A 82 – Specification for Steel Wire, Plain, for Concrete Reinforcement

B. American Concrete Institute (ACI), latest edition
   1. ACI 315 – Details and Detailing of Concrete Reinforcement
   2. ACI 318 – Building Code Requirements for Reinforced Concrete


D. Concrete Reinforcing Steel Institute (CRSI)
   2. CRSI Reinforcing Bar Detailing, 1999
   3. CRSI 63 – Recommended Practice for Placing Reinforcing Bars
   4. CRSI 65 – Recommended Practice for Placing Bar Supports

1.04 SUBMITTALS

A. Certified Mill Test Reports for steel.

B. Detail and placement drawings. Submit in accordance with Section 01300 at least 14 days prior to reinforcement fabrication.
   1. Reinforcing steel shall be detailed in accordance with the "ACI Detailing Manual" (SP-66), ACI Committee 315; CRSI; and in conformance with the project drawings.
   2. Shop drawings shall include sufficient plan, section, and elevation drawings of all beams, walls, slabs, footings, columns, and other shapes to clearly show all reinforcement details, spacing, and sizes.
   3. Bends, splices, hooks, ties and all other details shall be shown. Drawings shall indicate any fieldwork required.
4. Shop drawings shall show steel specifications and conformance.

C. Samples of all proposed bar supports with a written description of where each support is proposed to be used.

1.05 QUALITY ASSURANCE

A. Coordinate with other Trades affecting or affected by Work of this Section.

B. Bends, hooks, laps, splices, cover, and other details shall conform to UBC, Chapter 19; and ACI 318, except where more stringent requirements are shown in the drawings or specified herein.

C. Perform reinforcement work in accordance with CRSI Documents 63 and 65.

D. Conduct field measurements as necessary prior to fabrication. Conform to the approved detail and placement drawings.

E. All materials shall be new, unused, specifically manufactured for the intended purpose.

F. Any welding shall be conducted by persons with Welder Certification in accordance with AWS D1.4.

1.06 DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered properly bundled and labeled to show grade, size and location. Deformed bars shall be marked with the letter “S” per ASTM A 615. Deliver with suitable hauling and handling equipment.

B. Properly store materials to protect from moisture. Cover steel with waterproof covering and store so that materials are not against unprotected earth.

C. Handle material carefully to protect from cuts, nicks, kinks, deformation, and other damage. Ensure worker safety.

PART 2 PRODUCTS

2.01 REINFORCEMENT MATERIALS

A. Reinforcing Bars for Concrete
   1. All structural reinforcement shall be deformed bars.
   2. Deformed billet steel; ASTM A 615, Grade 60 or Grade 40

B. Welded Wire Fabric
   1. Use only where shown.
   2. Supply flat sheets; ASTM A 185 with wire conforming to ASTM A 82
   3. 6-inch by 6-inch mesh spacing
   4. Wire Size: W1.4, unless otherwise shown on drawings.

2.02 ACCESSORIES

A. Provide all accessories necessary for proper reinforcement placement, spacing, support, and fastening. Bricks, broken CMU, spalls, rocks or similar materials shall not be used for support of reinforcing steel.

B. Tie Wire: 16-gauge minimum, black annealed steel; acceptable patented system.
C. Bar Supports, Bolsters, Chairs and Spacers
   1. Sized and shaped for strength and support of reinforcement during installation and placement of concrete. Use only approved materials.
   2. High density concrete dobies. Compressive strength equal or greater than concrete to be placed. No plastic or low cement content dobies accepted.
   3. Chairs: Stainless steel. With plastic tips when used at surfaces that will be exposed to view.
   5. Plastic Shims may be used to support plastic spacers.

**PART 3 EXECUTION**

3.01 PREPARATION

A. Verify that surfaces to receive reinforcement are accurately sized and located, square, plumb, rigid, secure, and otherwise accurately prepared.

B. Prior to starting Work, notify General Contractor about defects requiring correction.

C. Reinforcement shall be free from mud, oil or other nonmetallic coatings that decrease bond.

D. Remove surface rust and mill scale with wire brush. Heavily rusted bars shall not be used.

E. Do not start Work until conditions are satisfactory.

3.02 PLACEMENT

A. Perform reinforcement work in accordance with CRSI Documents 63 and 65, and fabricate in compliance with ACI 315.

B. Conform to approved placement and detail drawings and specified tolerances herein.

C. Reinforcement shall be accurately placed and adequately supported before concrete is placed, and shall be secured against displacement within the tolerances of this section.

D. All reinforcement shall be bent cold unless otherwise permitted by the Engineer.

E. Reinforcement partially embedded in concrete shall not be field bent unless approved by the Engineer.

F. Do not weld splices, crossing bars, or other locations.

G. Splices: Locate splices not indicated on the drawings at points of minimum stress. Development length and splices shall conform to UBC Section 1912. At wire mesh, lap one full mesh plus 2-inches. Clear distance between spliced bars shall conform to UBC Section 1907.6. Splices of adjacent bars shall be staggered. Use greater splice lengths where shown in the drawings.

H. Spacing: Comply with UBC Section 1907.6, contract drawings, and approved shop drawings.

I. Protective Concrete Cover: Comply with UBC Section 1907.7.1 minimums. Provide greater cover where shown in the drawings.
Bars in slabs shall be supported on well-cured concrete blocks or approved metal chairs.

Tolerances:
1. Concrete Cover: Plus or minus ¼ inch.
2. Spacing Between Bars: ¼ inch.

Bar relocation to avoid interference with other reinforcement, conduits or embedded items: 1 bar diameter, unless otherwise approved by Engineer.

Reinforcement around openings: Unless otherwise shown on the drawings, place at least double the area of steel removed by the opening around the opening and extend on each side sufficiently to develop bond in each bar. At square or rectangular openings, place at least one diagonal bar at each corner.

3.03 PROTECTION

A. Protect other Work against damage and discoloration caused by Work of this Section.

B. Protect placed reinforcement from subsequent movement and inclement weather until concrete is placed.

3.04 FIELD QUALITY CONTROL

A. The Engineer shall be notified when reinforcing steel is ready for inspection. Inspection must occur before any concrete is placed.

B. Notify Engineer at least 48 hours in advance and allow sufficient time for inspection.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Cost for concrete reinforcement work shall be included as a portion of the lump sum costs for the Control Building as stated in the Bid Form. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 03300 CAST-IN-PLACE CONCRETE

PART 1  GENERAL

1.01  SUMMARY

A. This section includes work required to supply, place, finish and cure cast-in-place concrete, including mix design, certifications, submittals and testing.

B. Furnish and install vapor barrier and sand base under floor slabs-on-grade.

C. Installation of inserts, sleeves, anchor bolts, grounding cable and other items embedded in concrete, but furnished under other sections.

D. Rinsing out of transit mix trucks, washing or wetting of concrete, site cleanup, or other activity related to water at the site shall be in conformance with all EPA requirements for the prevention of water runoff to storm water sewers or creeks.

1.02  RELATED SECTIONS

A. Section 03110 – Structural Cast-In-Place Concrete Forms
B. Section 03152 – Premolded Expansion Joint Fillers
C. Section 03200 – Concrete Reinforcement
D. Section 07920 – Joint Sealants

1.03  REFERENCES

A. American Standards for Testing and Materials (ASTM), latest editions
   1. ASTM C31 – Standard Specification for Making and Curing Concrete Test Specimens in the Field
   2. ASTM C33 – Specification for Concrete Aggregate
   3. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
   5. ASTM C143 – Standard Test Method for Slump of Hydraulic Cement Concrete
   7. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
   8. ASTM C260 – Standard Specification for Air Entrained Admixtures for Concrete
 10. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete
 11. ASTM C618 – Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

B. American Concrete Institute (ACI), latest editions
   1. ACI 301 – Standard Specification for Structural Concrete in Buildings
2. ACI 304R – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
3. ACI 305R – Recommended Practice for Hot Weather Concreting
4. ACI 306R – Recommended Practice for Cold Weather Concreting
5. ACI 309R – Guide for Consolidation of Concrete
6. ACI 318 – Building Code Requirements for Reinforced Concrete
7. ACI SP-15 – Field Reference Manual (*have copy on-site*)

1.04 SUBMITTALS

A. Contractor is responsible for the design of the concrete mix that shall conform to ASTM C94 and the requirements of this section.

B. Certified Mix Design: Prior to delivery of concrete, and allowing sufficient time for review, submit three copies of mix design, for each type of concrete, showing all materials used and proportions matching units specified. Submittal shall allow for easy comparison to the specifications and shall show all material compliances. Submittal shall clearly identify the mix as proposed for this project, with project name shown.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301.
B. Conform to ACI 305R in hot weather.
C. Conform to ACI 306R in cold weather.
D. Installer Qualifications: Concrete work shall be finished by persons with at least 5 years experience with work of similar scope and quality.
E. No chloride containing admixtures shall be used.
F. On-Site water addition to concrete will not be permitted.
G. Conduct field-testing as specified.
H. Admixtures shall be added in strict conformance with the manufacturer's instructions.

1.06 DELIVERY

A. Concrete shall be scheduled and delivered in a timely manner in accordance with ASTM C94 and ACI 304R. Ensure that forms and reinforcement are complete and ready to accept concrete prior to scheduling delivery.

B. When installing a continuous pour section, ensure that trucks arrive and concrete is placed with no greater than 45 minutes elapsing between lifts.

**PART 2 PRODUCTS**

2.01 PORTLAND CEMENT

A. Conforming to ASTM C150. Type I and Type II where designated.
B. Use same brand and source of cement throughout the project.
2.02 WATER

A. Water used for mixing shall be clean and potable.

2.03 AGGREGATE

A. Aggregates shall be natural materials conforming to ASTM C33 as modified herein.

B. Aggregates shall be nonreactive as defined in ASTM C33 and tested per ASTM C289.

C. Aggregate shall contain no soil, friable particles, organic matter, or other deleterious materials. Aggregate shall be washed prior to use in the concrete mix.

D. Aggregates shall contain no chert, limestone, or shale.

E. Coarse Aggregate:
   1. Use coarse aggregate from only one source for exposed concrete in a single structure.
   2. Coarse aggregate shall be smooth, rounded and uniform. No more than 15% shall be elongated (max. dimension 5 times min. dimension).
   3. Coarse aggregate shall be durable, sound and hard.
   4. Maximum Size: 1-inch, but not more than one-fifth of narrow dimension between sides of Formwork, one-fourth depth of slab, nor three fourths of narrowest distance between Reinforcing Steel.

F. Fine Aggregate:
   1. Use fine aggregate from only one source for exposed concrete in a single structure.
   2. Fine aggregate shall not exceed 40% by weight of combined aggregate total, except when coarse aggregate maximum size is ½-inch or less.
   3. Fine aggregate shall be durable, sound, clean and hard.
   4. Sand Equivalent of 75 minimum per ASTM D2419.

G. Combined (Coarse and Fine) Gradation per ASTM C136:

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<thead>
<tr>
<th>US Standard Sieve</th>
<th>% Passing by Weight</th>
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<tr>
<td>1½-inch</td>
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<tr>
<td>No. 200</td>
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</table>
2.04 ADMIXTURES

A. General:
1. When two or more admixtures are used, they shall be certified by the manufacturer(s) to be compatible.
2. Chlorides are not permitted in any form.
3. Air Entraining and Water Reducer admixtures are required.
4. All admixtures shall be added at the batch plant, unless otherwise specified.

B. Fly Ash:
1. Conforming to ASTM C618, Class F except maximum ignition loss shall not exceed 30% by weight.
2. Fly ash may be used to replace up to 15% by volume of the Cement content, provided that the mix strength is substantial by test data.
3. Fly ash shall be produced from a single known and consistent source.

C. Midrange Water Reducer:
1. Shall conform to ASTM C494, Type A and F.

D. High-Range Water Reducer (Superplasticizer):
1. Shall conform to ASTM C494, Type F or G; and ASTM C1017, Type I or II.
2. Master Builders, Inc. "Rheobuild"; or approved equal.

E. Air-Entraining Admixture:

F. Fibrous Concrete Reinforcement: Shall be “Fibermesh MD” added at a minimum of 1.5 pounds per cubic yard. Use where specified or shown on the drawings.

G. Others: Only as approved and deemed necessary.

2.05 BONDING AGENT

A. Required where new concrete is poured against existing concrete, and on embedded items with less than 1½-inches of cover.

B. 100% solids, two component epoxy bonding compound meeting ASTM C881, Type II, Grade 2, Class B or C materials except as modified herein.

C. Properties:
1. Bond Strength @ 14 days (ASTM C882) – 1800 psi minimum
2. Tensile Strength @ 7 days (ASTM D638) – 4400 psi minimum
3. Tensile Elongation @ 7 days (ASTM D638) – 1.49% maximum

D. Master Builders, Inc. “Concre sive Liquid PL”; or approved equal.

2.06 CURING COMPOUNDS AND SEALERS

A. Evaporation Reducer: Spray applied monomolecular film that reduces the rate of surface moisture evaporation, minimizes plastic shrinkage, and does not effect the cement hydration process. Master Builders, Inc. “Confilm”; WR Meadows “Sealtight Evapre”; or approved equal.

B. Exterior Use Liquid Membrane-Forming Curing Compound: Shall conform to ASTM C309, Type I, Class B and ASTM C1315, Type 1, Class A. WR Meadows “CS-309-25”; or approved equal.

C. Interior Use Liquid Membrane-Forming Curing Compound: Water-base acrylic curing and sealing compound conforming to ASTM C309, Type I, Class B and ASTM C1315, Type 1, Class A. WR Meadows “Vocomp-25-1315”; or approved equal.

D. Concrete Sealer: Non-yellowing, acrylic co-polymer solution meeting ASTM C309, Type 1, Class B and ASTM C1315, Type 1, Class A. WR Meadows “TIAH 1315”; or approved equal.

2.07 CONCRETE HARDENERS

A. Liquid concrete densifier and hardener, chemical resistant, colorless, with 100% active chemicals. WR Meadows “Liqui-Hard”; or approved equal.

2.08 VAPOR BARRIER

A. ASTM D2103 – Polyethylene Film and Sheeting, 6 mils thickness.

2.09 STRUCTURAL REPAIR MORTAR

A. Shrinkage compensated, rheoplastic, one-component, cementitious based, hand or low velocity spray applied material suited for repairing distressed horizontal, vertical or overhead concrete.

1. Compressive Strength @ 24 hours (ASTM C109) – 3500 psi min.
2. Flexural Strength @ 28 days (ASTM C348) – 1300 psi min.
3. Freeze Thaw Resistance @ 300 cycles (ASTM C666-A) – 90% RDF min.
4. Modulus of Elasticity @ 28 days (ASTM C469) – 4.3x10^6 psi

B. Master Builders, Inc. “Emaco S” Series; or approved equal.

2.10 STANDARD CONCRETE MIX

A. Use: Footings, Interior Slabs, Exterior Walks

B. Mix Design Requirements:

1. Cement: Portland Cement, Type I or II, ASTM C150
2. Water / Cementitious Materials Ratio: 0.45-0.50 by weight
PART 3 EXECUTION

3.01 PREPARATION

A. Examine all reinforcement, formwork, waterstops, premolded joint fillers, and other embedded items to ensure they are accurately placed, properly secured and cleaned.

B. Ensure that inspection of reinforcement is complete and installation approved.

C. Ensure concrete mix design and test certifications have been submitted and approved.

D. Ensure that all required materials and equipment are on-site and operable.

E. Ensure that subgrade and base rock are properly placed and compacted. Place vapor barrier and leveling sand at slab-on-grade locations. Sprinkle subgrades and other porous surfaces with water to reduce adsorption.

F. Apply form release agent to formwork.

G. Apply bonding agent where required.

H. Notify General Contractor of work requiring correction. Do not start work until conditions are satisfactory.

I. Review for various locations to receive different types of concrete mixes.

J. Notify Engineer at least 24 hours in advance of concrete placement.

3.02 VAPOR BARRIER AND SAND COVER

A. Place vapor barrier on top of rock base under all interior slabs-on-grade. Barrier shall be continuous under construction joints. The edges of the vapor barrier shall be lapped and taped, and all projections through it shall be taped and sealed.

B. The vapor barrier shall be covered with a sand cover, 2-inches thick or as shown on the drawings. At the time of placing concrete, the sand shall be damp but excess water shall not be trapped on top of the vapor barrier.

3.03 CONCRETE PLACEMENT

A. Comply with ACI 304 and ASTM C94, and ACI 305R and 306R as required.

B. Convey and place by methods with will prevent material separation, segregation, and loss.

C. Deposit concrete continuously or in layers so that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or other planes of weakness. Where seams are unavoidable, provide construction joints as directed.
D. Do not convey pneumatically placed concrete through aluminum pipe.

E. Do not retemper concrete, or add water on-site for other reasons.

F. Use trunks or tremies when pouring walls to ensure concrete does not drop or fall more than 4 feet. Place in layers not exceeding 2 feet in depth.

G. Screed all slabs to true levels or slopes, true within ¼ inch per 10 feet. Evenly slope to any drain at 3/16 inch per foot, unless otherwise shown on Drawings.

H. When mean temperature exceeds, or is expected to exceed 80°F during placement and finishing operations, steps shall be taken in accordance with ACI 305R to reduce concrete temperature and water evaporation. Slabs will be fog sprayed from the completion of screeding until curing is begun (except during troweling). Submit detailed hot weather concreting procedure to Engineer for approval at least 2 days prior to planned placement.

I. When mean temperature falls below, or is expected to fall below 40°F, comply with ACI 306R. Concrete shall be protected from freezing by means acceptable to the Engineer. Submit detailed cold weather concreting procedure to Engineer for approval at least 2 days prior to planned placement.

3.04 CONSOLIDATION

A. Employ mechanical, high frequency vibrators to consolidate concrete around reinforcement, into corners and angles of formwork, and to exclude rock pockets, air bubbles and honeycomb.

B. Vibration shall be in accordance with ACI 309. Vibrator frequency shall be between 8000 and 12000 rpm.

C. Hold Vibrator in one spot no longer than 15 seconds; keep in constant motion, insert and withdraw at points approximately 18 inches o.c.

D. Maintain vibrator in vertical position when penetrating concrete walls. At slabs, hold vibrator perpendicular to the surface at all times.

E. Vibrate each successive lift. Extend vibrator into previous lift to avoid seams.

F. Transporting concrete with vibrator is not permitted.

G. Maintain spare vibrator at jobsite during concrete placement.

3.05 CONTROL JOINTS

A. Form to true, straight lines, with adjacent slab sections flush at Joints. Make panels as close to square as possible.

B. Conform to ACI 302 and the Project Drawings. If not shown, submit control joint layout plan to Engineer for approval.

C. Joints shall be formed by tooling into fresh concrete. The joint shall be perpendicular to the concrete surface and ¼ of the thickness of the slab. Zip strips not allowed.
D. Fill joint as specified in Section 07920.

E. Extend Reinforcement through Joints, unless otherwise shown on Drawings.

F. If necessary, and approved by Engineer, joint may be saw cut as soon as concrete has sufficiently hardened to prevent dislodging of aggregates. Saw continuous slots perpendicular to surface and ¼ of slab thickness. Must be complete within 12 hours of concrete placement.

3.06 FINISHES

A. Rough Form Finish
   1. Finish resulting after form removal with fins or projections exceeding ¼-inch removed, and with tie holes and defective areas repaired and patched.
   2. Location: Formed concrete surfaces not exposed to view in the finished structure.

B. Standard Smooth Finish
   1. As-cast surface with all fins and projections completely removed and smoothed, and with all tie holes and defective areas repaired and patched for a uniform, smooth appearance.
   2. At unformed surfaces, such as tops of walls, strike-off smooth and finish with a texture matching adjacent surfaces.
   3. Location: Formed surfaces exposed to view in the finished structure.

C. Float Finish
   1. After placing slabs, do not work the surface 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 by hand-floating if area is small or inaccessible to power units.
   2. Check the level of the surface plane to a tolerance not exceeding ¼-inch in 10 feet when tested with a 10-foot straightedge placed on the surface in not less than two different angles from a reference point. Cut down high spots and fill low spots. Uniformly slope surfaces to drain where shown on the drawings.
   3. Immediately after leveling, refloat the surface to a uniform, smooth, granular texture. Do not overfinish.
   4. Location: Monolithic slab surfaces that are to receive a trowel finish and other finishes.

D. Trowel Finish
   1. After floating, begin the first trowel finish operation using a power driven trowel. 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.
   2. Do not absorb wet spots with neat cement or cement-sand mixture, and do not use chemical dryers.
3. Location: Monolithic slab surfaces exposed to view, or to be covered with resilient floor covering, or to receive liquid hardener treatment.

E. Non-slip Broom Finish

1. After concrete has received floating finish specified above, provide light brushing with fiber-bristle broom perpendicular to traffic flow.

2. Location: Exterior walks and other horizontal walking surfaces.

3.07 CONCRETE SURFACE REPAIRS

A. After removal of forms, repair and patch defective areas with specified repair mortar.

B. In honeycomb and rock pocket areas, saw cut area and remove material down to solid concrete. Saw cut edges perpendicular to the concrete surface. Thoroughly clean out loose material, saturate area with water to a saturated surface dry condition and brushcoat the area to be patched with a slurry coat of structural repair mortar. Place additional mortar to patch the area before the slurry coat has dried. Smooth and blend to surrounding surface. Do not feather edges.

3.08 CONCRETE CURING AND PROTECTION

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Protect concrete from rapid moisture loss before and during finishing operations with a fog spray or evaporation reducer. Apply evaporation reducer in accordance with manufacturer’s instructions after screeding and bull floating, but before power floating and troweling.

B. Curing shall begin as soon as the finishing operation has been completed and the surface will not be damaged by the curing method. Curing shall be maintained for not less than 7 days.

C. Curing Methods: Perform curing of concrete by curing compound, by moist curing, by moisture-retaining cover curing, or combinations thereof, as specified herein.

1. Moist Curing. Use one of the following methods
   a) Keep concrete surface continuously wet by covering with water
   b) Use continuous water-fog spray
   c) Cover concrete with absorptive cover (burlap cloth, 9 oz./s.y.), thoroughly saturate with water, and keep continuously wet. Completely cover all concrete and lap edges 4-inches. Place moisture retaining cover (polyethylene film) over absorptive cover.

2. Moisture-Retaining Cover. Cover all surfaces completely with polyethylene sheets, lap edges at least 3-inches, and seal with waterproof tape. Immediately repair any holes or tears with sheet material and tape.

3. Curing Compound. Use specified compound and apply in accordance with manufacturer’s instructions. Apply within 1 hour of final finishing operations or form removal. Maintain continuity of coating and protect from damage during curing period. If finish materials are to be applied later, follow manufacturer’s instructions for compound removal.
D. Exterior Structural Concrete: Cure for 7 days with moist cure or moisture-retaining cover. After 7 day period, apply specified or approved sealing compound to surfaces that will be exposed in the finished structure.

E. Exterior Sidewalks and Ramps: Cure for 7 days with moist cure or moisture-retaining cover. After 7 day period, apply specified or approved sealing compound to surfaces that will be exposed in the finished structure. Or; cure for 7 days using specified or approved exterior curing/sealing compound.

F. Interior Slabs to be Covered (with resilient flooring): Cure for 7 days with moist cure or moisture-retaining cover. Or; cure for 7 days using specified or approved interior curing/sealing compound. Ensure compound compatibility with adhesives.

G. Interior Slabs Exposed and Other Exposed Interior Concrete: At interior slab locations that will remain uncovered, interior curbs, equipment pads, etc., cure for 7 days with moist cure or moisture-retaining cover. After 7 days, or as recommended by the manufacturer, apply liquid chemical hardener. Follow manufacturer’s instruction for hardener application. Apply at least two coatings unless otherwise recommended by the manufacturer and approved. Protect adjoining work from overspray and remove all excess hardener from surface of floor slab.

H. Protect all surfaces from damage until curing is complete and sealers and hardeners have dried.

3.09 CORRECTION OF DEFECTIVE WORK

A. Remove and replace any concrete which shows excessive cracks or severe damage. Remove and replace slabs which do not drain properly, or are improperly finished, and other defective concrete as directed.

B. Should concrete fail to meet the minimum specified 28 day strength as determined by tests on both the regular and spare cylinders, the concrete will be deemed defective and shall be removed and replaced. Contractor shall bear the entire cost of such testing, removal, redesign, and replacing of defective concrete.

C. Concrete which has improper water/cement ratios, and/or improper air contents shall be removed and replaced as directed.

D. Contractor shall bear all costs for removal and replacement of defective work.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Cost for concrete and other work in this section shall be included as a portion of the lump sum bid item for the Control Building, as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 03600 GROUT

PART 1 GENERAL

1.01 SUMMARY
   A. Section includes various types of grout as may be required for the project as shown on
      the Drawings and as required.
   B. Work includes supply, preparation, mixing, application, finishing and curing of grout.

1.02 RELATED SECTIONS
   A. Section 03200 – Concrete Reinforcement
   B. Section 03300 – Cast-In-Place Concrete
   C. Miscellaneous Sections of Divisions 5 and 11 for anchor bolts, base plates and other
      materials to be grouted or bonded in place.

1.03 REFERENCES
   A. ASTM C1107 - Standards Specification for Packaged Hydraulic-Cement Grout
      (Nonshrink)
      Mortars – Modified
   C. ASTM C1090 - Standard Test Method for Measuring Changes in Height of Cylindrical
      Specimens from Hydraulic Cement Grout
   D. ASTM C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete
      (Flow Cone Method)
   E. ASTM C827 – Test Method for Early Volume Change of Cementitious Mixtures
   F. ASTM C882 – Test Method for Bond-Strength of Epoxy-Resin Systems Used with
      Concrete.
   G. ACI 351 - Grouting for Support of Equipment and Machinery

1.04 SUBMITTALS
   A. Submit list of each type of grout proposed for each location to be grouted. Include
      manufacturer’s specifications, use recommendations, surface preparation and application
      instructions, and protection of adjacent surfaces.
   B. Submit three copies of submittal package. Grout shall be approved prior to use.

1.05 QUALITY ASSURANCE
   A. Grout Manufacturer shall be consulted when questions arise during selection of a
      particular grout for application. Grout used shall be as recommended by the
      manufacturer for each type of application.
   B. Grout shall be mixed, placed and cured in strict conformance to the manufacturer’s
      instructions. Surfaces to be grouted shall be carefully prepared according to the
manufacturer’s instructions. Improper surface preparation and curing are the most common causes of grout failure and problems.

1.06 DELIVERY, STORAGE AND HANDLING
A. Deliver materials in manufacturer’s sealed containers with contents clearly labeled.
B. Store materials in a dry area at a temperature between 40 and 100°F.

PART 2 PRODUCTS
2.01 STANDARD NON-SHRINK GROUT
A. Non-metallic, non-bleeding, cement based non-shrink grout meeting ASTM C1107, Grades B or C. Pumpable and pourable with positive expansion per ASTM C827.
B. Compressive Strength at Flowable Consistency per ASTM C109: 2500 psi at 1 day, 5000 psi at 3 days, and 8000 psi at 28 days (minimums).
C. Use: Grouting around pipe and conduit penetrations in concrete slabs, and other locations where non-shrink grout is called for and other specified grouts are not required.
D. Manufacturers: Dayton Superior Corp. “1107 Advantage Grout”; ThoRoc “621 Construction Grout; EUCO “NS Grout”; or approved equal.

2.02 PRECISION NON-SHRINK GROUT
A. High performance, non-metallic, non-bleeding, non-gaseous, chloride-free, cement based non-shrink grout meeting ASTM C1107, Grade C. Pumpable and pourable, vibration resistant, and heat and thermal shock resistant. Positive expansion per ASTM C827 and ASTM C1090.
B. Expansion: 0.01-0.07% at 1 day and 0.02-0.07% at 28 days when tested per ASTM C1107 in Fluid State.
C. Compressive Strength at Fluid Consistency per ASTM C1107: 4000 psi at 1 day, 6000 psi at 3 days, and 9000 psi at 28 days (minimums).
D. Use: Under base plates of equipment and other items where grout base is shown in the drawings or required.
E. Manufacturers: Dayton Superior Corp. “Sure-Grip High Performance Grout”, “1107 Advantage Grout”; EUCO “Hi-Flow Grout”; or approved equal.

2.03 DRY PACK GROUT
A. Cement based, non-shrink, noncorrosive, non-metallic, high density, high strength grout for dry pack applications. Meets COE CRD-C-621.
B. Compressive Strength per ASTM C109: 3000 psi at 1 day, 6500 psi at 7 days, and 8000 psi at 28 days (minimums) at damp pack consistency.
C. Use: Pipe penetration patches in precast concrete, overhead applications and other areas where poured or pumped grout use is not practical.

2.04 EPOXY GROUT

A. Multi-component, pre-proportioned epoxy grout. High impact and vibration resistance.
B. Compressive Strength per ASTM D695 at 50°F: 9200 psi at 1 day and 12000 psi at 14 days
C. Tensile Strength per ASTM D638 at 10 days: 2600 psi minimum
D. Flexural Strength per ASTM D790 at 14 days: 5000 psi minimum
E. Bond Strength per ASTM C882 at 14 days: 2200 psi minimum (to concrete)
F. Water Absorption per ASTM D570: 0.3%
G. Use: Deep pour applications (more than 4-inch thick), grouted rods and anchor bolts.
H. Manufacturers: Dayton Superior Corp. “Sure-Grip Epoxy Grout”; or approved equal.

2.05 ACCESSORIES

A. Aggregate: Washed pea gravel, maximum 3/8-inch size.
B. Water: Clean potable water.
C. Curing Compound: Water based, acrylic as recommended by grout manufacturer.

PART 3 EXECUTION

3.01 MIXING

A. Mix materials in accordance with the manufacturer’s instructions.
B. Where grout depth will exceed 2-inches, add aggregate at a maximum rate of 25 pounds per 55 pound bag.
C. Do not retemper mix.

3.02 PREPARATION

A. Carefully prepare all surfaces to be grouted in accordance with the manufacturer’s recommendations and as specified. Concrete must be cured for 28 days before placing grout.
B. Clean surfaces to remove loose and foreign material by waterblasting, mechanical abrasion, or sandblasting. Surface shall be free of dirt, oil, curing compounds and laitance.
C. Remove unsound concrete by chipping or grinding. Grind or sandblast steel surfaces to remove all rust, mill scale and paint.
D. Install forms to contain liquid grout. Seal joints and corners.
3.03 INSTALLATION – CEMENTITIOUS GROUTS

A. Follow manufacturer’s instructions.

B. Just prior to grouting, thoroughly saturate concrete surfaces for 24 hours; remove excess water.

C. Place grout continuously by most practical means. Work from one side to avoid entrapped air.

D. Grout may be rodded or tamped, but do not vibrate.

E. Apply curing compounds to exposed grout in accordance with manufacturer’s instructions or cure with wet burlap for 3 days. Curing shall commence immediately after placement.

3.04 INSTALLATION – EPOXY GROUTS

A. Follow manufacturer’s instructions.

B. Allow surfaces to dry completely before grouting.

C. Place grout continuously by most practical means. Work from one side to avoid entrapped air.

D. For grout depths exceeding 3 inches, place grout in maximum 3-inch lifts; allow each lift to cure before placing next lift.

E. Consolidate material to eliminate voids and air pockets.

F. Lightly mist exposed grout with solvent, then steel trowel to smooth surface. Do not apply curing compounds.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Grout and other work in this section shall be included within the lump sum basis for the amount stated on the Bid Form for the Project. No separate measurement or payment will be made for these quantities and items.

B. Payment for Grout shall be included within the respective unit prices for each type of pipe, manholes, services and associated appurtenance items. No separate measurement or payment will be made for these quantities and items.

END OF SECTION
### DIVISION 4 – MASONRY CONSTRUCTION
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SECTION 04050 – BASIC MASONRY MATERIALS AND METHODS

PART 1  GENERAL

1.01  SUMMARY

A. This Section describes the overall intent to provide a concrete masonry unit (CMU) Control Building.

1.02  WORK INCLUDED

A. Provide concrete masonry units (concrete block), reinforcement, mortar, and grout.

1.03  RELATED SECTIONS

A. Section 03200 – Concrete Reinforcement
B. Section 04065 – Masonry Mortar and Grout
C. Section 04220 – Concrete Masonry Units
D. Section 07920 – Joint Sealants

1.04  SUBMITTALS

A. Submit four (4) copies of all product data to engineer sufficiently early to avoid delays.
B. Manufacturer’s Data: Provide complete description of each type of unit and accessory.
C. Certificate of Materials: Prior to delivery of materials to jobsite, submit certification from manufacturer showing compliance for specification of CMU. Certify compliance with ASTM C90. Certify mortar and grout compliance.

1.05  QUALITY ASSURANCE

A. Contractor shall have at least 5-years experience, regularly engaged in masonry work.
B. Continuous active supervisory mason-foreman in attendance while masonry work is in progress.
C. Provide CMU test results per ASTM C140 for production run to be used.

1.06  DELIVERY, STORAGE AND HANDLING

A. Deliver, handle, and store concrete masonry units by means that will prevent damage and contamination by other materials.
B. Do not use reinforcing anchors having excessive rust or foreign coatings.

C. Do not use units with chips, cracks, voids, or materials that may cause staining.

D. Protect stored CMU from water absorption.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements: Comply with recommendations of IMIAWC (CW).

B. Hot Weather Requirements: Comply with recommendations of IMIAWC (HW).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Concrete Masonry Units – Provide concrete masonry units from one manufacturer, of uniform texture and color. Submit manufacturer’s data for approval. Mutual Materials, Oldcastle, Willamette Graystone, or approved equal.

B. Masonry Mortar and Grout – Mutual Materials DesignMix, or approved equal.

2.02 MATERIALS

A. Comply with material specifications of Sections 04065 and 04220.

2.03 ALTERNATIVE SUPPLIERS

A. Contractor may choose to purchase a pre-engineered CMU building package complete from a single supplier. If it is desired to utilize a CMU building package from a single supplier, some alterations to the building design may be allowed in order to comply with the supplier’s standard products. Provide submittals identifying deviations from building design shown on Plans.

PART 3 EXECUTION

3.01 INSTALLATION

A. Comply with installation guidelines of Sections 04065 and 04220.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

Cost for work and materials in this Section shall be included as a portion of the lump sum bid amount for the Control Building as stated on the Bid Form. No separate measurement for work in this Section will occur.

END OF SECTION
SECTION 04065 - MASONRY MORTAR AND GROUT

PART 1   GENERAL

1.01 SUMMARY

A. Mortar and grout for engineered CMU walls.

1.02 RELATED SECTIONS

A. Section 4220 – Concrete Masonry Units: for additional installation requirements for mortar and grout

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM), latest edition
   1. ASTM C91 – Specification for Masonry Cement
   2. ASTM C94 – Specification for Ready-Mix Concrete
   3. ASTM C143 – Test Method for Slump of Hydraulic Cement Concrete
   4. ASTM C144 – Specification for Aggregate for Masonry Mortar
   5. ASTM C150 – Specification for Portland Cement
   6. ASTM C207 – Specification for Hydrated Lime for Masonry Purposes
   7. ASTM C270 – Specification for Mortar for Unit Masonry
   8. ASTM C404 – Specification for Aggregates for Masonry Grout
   9. ASTM C476 – Specification for Grout for Masonry
   10. ASTM C1019 – Method of Sampling and Testing Grout
   11. ASTM C1142 – Specification of Ready Mixed Mortar for Unit Masonry
   12. ASTM C1329 – Specification for Mortar Cement


D. OSSC (Oregon Structural Specialty Code) 2014
   1. OSSC Chapter 14 – Exterior Walls
2. OSSC Chapter 21 – Masonry

1.04 SUBMITTALS

A. Submit manufacturer’s recommendations, product data, and test reports.

B. Submit Mortar Mix design.

C. Submit certificate that certifies ready-mixed or other mortar used conforms to these specifications.

D. Submit test reports on grout indicating conformance of component grout materials to requirements of UBC Standard 21-19, and test and evaluation reports to requirements of OSSC Standard 2103.12.

E. Submit test reports for mortar/grout materials indicating conformance to ASTM C270 and C476 property specifications.

1.05 QUALITY ASSURANCE

A. Blend cementitious materials, aggregate and admixtures in the factory under controlled conditions, which requires only the addition of water at the project site.

B. Use approved mix designs as long as aggregate characteristics remain unchanged. Upon significant changes in aggregate, prepare new mix designs and submit to Engineer.

C. Comply with ACI 530.1/ASCE 6 “Specifications for Masonry Structures” except as otherwise noted.

D. Review installation procedures and coordinate with other work that must be integrated with masonry.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver bulk, dry-blended ingredients to project site in enclosed containers on pallets sufficiently covered to keep dry.

B. Store mortar and grout mix in accordance with manufacturer’s printed instructions to prevent contamination by extraneous chemicals.

C. Maintain packaged materials clean, dry, and protected against dampness and foreign matter.

D. Provide preblended mortar and grout mix manufacturer’s recommended dispensing equipment for storage and controlled dispensing of mixtures.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Comply with IMIAC cold and hot weather requirements. When ambient air temperature is below 40°F, heat mixing water to maintain mortar temperature between 40° and 120°F until
placed.

B. Deliver products in reusable packages when possible. Return or recycle empty packaging.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS

A. Mutual Materials DesignMix, or approved equal.

2.02 MATERIALS

A. Portland Cement: ASTM C150, Type I or II; gray color. Fly ash, slag and pozzolans are not permitted. Do not use masonry cement mortars.

B. Mortar Cement: UBC Standard 21-14, Mortar Cement

C. Mortar Aggregates: ASTM C144, standard masonry type; clean, dry, protected against dampness, freezing and foreign matter.


E. Hydrated Lime: ASTM C207, Type S for masonry purposes. Do not use Type N.

F. Admixtures: WR Grace DryBlock, Sika Grout Aid.

G. Water: Potable.

2.03 MORTAR

A. Weigh dry mortar mix materials, including cementitious material, aggregate and admixtures, if approved, in a factory, under controlled conditions. Factory dry and preblend mortar ingredients.

B. Select proportions to produce workability and to provide optimum bond strength. Mix shall include the integral water repellent DryBlock or equivalent. Use as much lime as practical.

C. Mortar shall conform to the minimum property requirements given in Table II of ASTM C270, based on 28-day laboratory testing only. Mortar shall be Type ‘S’, 1800 psi for load-bearing walls above grade. Natural color. By volume (cementitious materials): 1 part Portland cement, ¼ to ½ part hydrated lime, with sand 2¼ to 3 times the sum of the volume of cement and lime.

D. Thoroughly mix, in quantities needed for immediate use. Mix mortar and grout for a period of time not less than 5 minutes or more than 10 minutes in a mechanical mixer with the amount of water required for the desired workability.
E. Add only clean, potable water at the project site. Slump 5 to 8-inches.

F. Use a batch type mixer in accordance with ASTM C270, subparagraph 6.3.

G. Use mortar within 2½ hours of mixing. Retempering is allowed in accordance with ASTM C270, subparagraph 6.4.

2.04 GROUT

A. Mix grout in accordance with ASTM C476 and ACI 530.1. Do not use anti-freeze compounds to lower the freezing point of grout. Proportion grout according to Table 2103.12 of OSSC.

B. Mix dry materials utilizing equipment designed to ensure uniform blending, and precision measuring devices to ensure uniformity from batch to batch. Mix may include Sika Grout Aid per manufacturer’s recommendations.

C. Add only clean, potable water at the project site.

D. Thoroughly mix, in quantities needed for immediate use. Mix mortar and grout for a period of time not less than 5 minutes or more than 10 minutes in a mechanical mixer with the amount of water required for the desired workability.

E. Use grout within 1½ hours after the initial mixing water has been added to the dry ingredients.

F. Grout Fill: Provide grout at CMU bond beams, lintels, and reinforced cells.

G. Compressive Strength: 2000 psi minimum at 28-days, determined in accordance with ASTM C1019.

H. Slump: 8-inches minimum, 10-inches maximum measured in accordance with ASTM C143.

I. Use coarse grout when grout space is equal to or greater than 4-inches in both directions. Use fine grout when grout space is smaller than 4-inches in either direction.

2.05 SOURCE QUALITY CONTROL

A. Maintain documentation of compliance to mix design. Keep a digital printout displaying the proper proportioning per batch as a permanent record. Deliver printout to Engineer and Owner.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and other specific conditions, and miscellaneous conditions affecting the performance of CMU.
B. Examine rough-in and built-in construction to verify actual locations of piping and other penetrations prior to installation.

3.02 INSTALLATION

A. Maintain an ambient temperature of the materials in contact with the mortar, of not less than 40°F. Follow IMIAC and OSSC instructions.

B. Lay hollow CMU with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings/slab and where adjacent to cells or cavities to be reinforced or filled with grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.

C. Maintain consistent 3/8-inch joints.

D. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units that have been set in position. If adjustment are required, remove units, clean off mortar and reset in fresh mortar.

E. Grouting: Do not place grout until entire height of masonry to be grouted has attained sufficient strength to resist grout pressure. Place carefully to avoid segregation of the grout materials. Do not allow coarse grout to fall more than 4-feet. Do not allow fine grout to fall more than 8-feet.

3.03 FIELD QUALITY CONTROL

A. Follow ACI 530.1 Testing and Laboratory Services.

B. Contractor shall hire an approved independent testing agency to take samples, perform tests, and submit results to Engineer. Tests shall show compliance with applicable specifications.

C. Mortar and grout samples shall be taken once every two weeks and additionally whenever mix design changes. Initial samples shall be taken during the first day of placement to ensure compliance before work progresses further.

D. Owner reserves the right to reject materials not in compliance with specifications and require the defective materials to be removed and replaced until compliance is achieved. No additional compensation will occur and contractor will promptly correct defective work.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Cost for work and materials in this Section shall be included as a portion of the lump sum bid amount for the Control Building as stated on the Bid Form. No separate measurement for work in this Section will occur.

END OF SECTION
SECTION 04220 - CONCRETE MASONRY UNITS

PART 1  GENERAL

1.01  WORK INCLUDED

A. Provide concrete masonry units (concrete block), reinforcement, flashing, weepholes, and accessories for complete installation of CMU walls.

B. Install steel reinforcing bars where shown.

C. Fill all cells containing steel reinforcing full with grout. Fill all other cells with specified insulation material.

D. Build-in work of other trades and coordinate with others as required.

1.02  RELATED SECTIONS

A. Section 04065 – Masonry Mortar and Grout

B. Section 07410 - Metal Roof Panels and Flashing

C. Section 07920 - Joint Sealers

D. Section 03200 – Concrete Reinforcement

1.03  REFERENCES

A. ASTM A 82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement, most recent.

B. ASTM A 153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware, most recent.

C. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement, most recent.

D. NCMA-TEK 72 – Bracing CMU Walls During Construction

E. ASTM C 90 - Standard Specification for Loadbearing Concrete Masonry Units, most recent.

F. ASTM C 476 – Grout for Reinforced and Non-Reinforced Masonry

G. ASTM C 780 – Mortar for Unit Masonry (utilizing ASTM C-1586-04, Guide for Quality Assurance of Mortars)


1.04  SUBMITTALS

A. Submit to engineer for approval sufficiently early to avoid delays.
B. Manufacturer’s Data: complete description of each type of unit product and accessory.

C. Certificate of Materials: Prior to delivery of materials to jobsite, submit certification from manufacturer showing compliance for specification of CMU. Certify compliance with ASTM C90. Certify mortar and grout compliance.

1.05 QUALITY ASSURANCE

A. Contractor shall have at least 5-years experience, regularly engaged in masonry work.

B. Continuous active supervisory mason-foreman in attendance while masonry work is in progress.

C. Provide CMU test results per ASTM C140 for production run to be used.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store concrete masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Do not use reinforcing or anchors having excessive rust or foreign coatings.

C. Do not use units with chips, cracks, voids, or materials that may cause staining.

D. Protect stored CMU from water absorption.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements: Comply with recommendations of IMIAWC (CW).

B. Hot Weather Requirements: Comply with recommendations of IMIAWC (HW).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide concrete masonry units from one manufacturer, of uniform texture and color. Submit manufacturer’s data for approval. Mutual Materials, Oldcastle, Willamette Graystone, or approved equal.

2.02 CONCRETE MASONRY UNITS

A. Concrete Masonry Units (CMU):

1. Load-Bearing Units: ASTM C90-00, Grade N; light gray, high strength concrete with net area compressive strength of 2000 psi; manufactured with integral water repellent (Dry Block by WR Grace or equivalent). Block shall also meet UBC Standard 21-4.

2. Size: Standard units with nominal face dimensions of 8 x 16 inches and 8-inch nominal depths. Cells containing reinforcement shall be a minimum of 2.5-inches wide and 4-inches long.


4. Shrinkage: CMU shall not exceed 0.06% linear shrinkage in accordance with ASTM C90.
5. Type: Single-side Split Face blocks required.

6. Obtain CMU from one manufacturer, of uniform texture and color for each kind required, for each continuous area and visually related areas.

2.03 MORTAR AND GROUT MATERIALS

A. Mortar: As specified in Section 04065.

B. Grout: As specified in Section 04065.

2.04 REINFORCEMENT AND ANCHORAGE

A. Reinforcing Steel: ASTM A 615 Grade 60 deformed billet bars. Clean and new.

B. Single Wythe Joint Reinforcement: Truss type; ASTM A 82 steel wire, hot dip galvanized after fabrication to ASTM A 153, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

2.05 FLASHINGS

A. Stainless steel drip edges. Stainless steel or EPDM flashings. Stainless steel interior termination angles. Stainless Steel minimum thickness of 0.01-inch.

C. Lap Sealant: Type as recommended by Sealant Manufacturer.

2.06 ACCESSORIES

A. Preformed Control Joints: Rubber, neoprene, or polyvinyl chloride material; provide with corner and tee accessories, fused joints.

B. Building Paper: ASTM D 226, Type I ("No. 15") asphalt felt.

C. Insulation: Korfil Block Insulation or loose fill Perlite in all un-grouted concrete masonry unit cells forming the exterior envelope.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive concrete unit masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

D. Ensure that reinforcing is clean and free from rust.

E. Ensure all surfaces to receive mortar are clean.

3.02 PREPARATION

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: as shown in the drawings.
   2. Coursing: One unit plus one horizontal joint equals 8 inches.

3.03 LAYING MASONRY UNITS

A. Prior to grouting, the grout space shall be completely clean so that all spaces to be filled with grout do not contain mortar projections greater than ½-inch, mortar droppings or other foreign material. Grout shall be placed so that all spaces designated to be grouted shall be filled with grout and the grout shall be confined to those specific spaces. Grout pours shall be limited to 5-feet in height.

B. Lay hollow masonry units with face shell bedding on head and bed joints. All head and bed joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the shell. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

C. Remove excess mortar as work progresses. Mortar fins shall be minimized and prevented from separating and falling into the cell.

D. Interlock intersections and external corners, except for units laid in stack bond.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. Perform cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

G. Spread mortar bed joints to a uniform thickness with fresh mortar. Do not throw mortar scrapings or slushing mortar into joints. Excessive furrowing of bed joints will not be permitted.

H. Tool joints smooth, dense and slightly concave.

I. Joint dimension shall be 3/8-inch +/- 1/8-inch. Vertical joints shall fall on the centerline of the unit below.

J. Lay masonry units plumb, true to line, and with accurately spaced level courses. Maximum variation from plumb and plan is ¼-inch in 10 feet.

K. Install bond beam where shown on the drawings using bond beam units. Reinforce as shown and fill with grout. Lap horizontal and vertical reinforcement 30 diameters or 18-inches whichever is greater.

L. Where bond beams are used for lintels, extend at least 24-inches or 40 bar diameters, whichever is greater, past the opening.

M. Place rebar positioners to hold vertical reinforcement away from CMU cell walls.

N. Provide weep holes (0.1 to 0.2 square inches) 32-inches on center in bottom course head joint immediately above the base flashing. Provide screening or other means to prevent Perlite insulation from displacing through weep holes.
O. Cells with reinforcement shall be grouted full. All other cells shall be filled with insulation.

P. Use smooth blocks at bottom course, top course, and course above window and door openings. All other courses to be one textured face split face with smooth side to the interior of building.

Q. When grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout not less than ½-inch below the top of the uppermost unit grouted. Clean exposed surface of loose material prior to restarting pour.

3.04 REINFORCEMENT AND ANCHORAGE

A. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend reinforcement a minimum of 24-inches beyond each side of opening.

B. Place continuous joint reinforcement in first and second joint below top of walls.

C. Place reinforcing bars as indicated on drawings. Support and secure bars from displacement; maintain within ½-inch of dimensioned position.

D. Reinforcing shall be secured against displacement prior to grouting by wire positioners or other suitable devices at intervals not to exceed 200 bar diameters.

3.05 FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

1. Extend flashings full width at such interruptions and at least 4 inches into adjacent masonry or turn up at least 4 inches to form watertight pan. At interior exposed locations, turn up 1-inch to form pan

2. Remove or cover protrusions or sharp edges that could puncture flashings.

3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Extend metal flashings through exterior face of masonry and turn down to form drip. When EPDM is used as flashing, provide stainless steel drip edge at exterior.

C. Lap end joints of flashings at least 4 inches and seal watertight with mastic or elastic sealant.

3.06 ADJUSTING AND CLEANING

A. Remove excess mortar and mortar smears as work progresses; replace defective mortar with mortar matching adjacent work.

B. Clean soiled surfaces with cleaning solution, using non-metallic tools. Ensure solution compatibility with painting requirements.

C. At end of each days work, and after final pointing, clean all exposed masonry by dry brushing. Protect walls overnight during inclement weather.

3.07 PAINTING

A. Paint block per Division 9.
PART 4  SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

   A. Cost for work and materials in this Section shall be included as a portion of the lump sum bid amount for the Control Building as stated on the Bid Form. No separate measurement for work in this Section will occur.
## DIVISION 5- METALS
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SECTION 05080 – HOT-DIP ZINC COATING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Specifications for applying protective coating to structural metals, anchor bolts, fasteners, and other metal hardware.

1.02 DESIGN REQUIREMENTS

A. As specified herein.

1.03 REFERENCES

A. ASTM A123-89 Zinc (hot-dip galvanized) Coatings on Iron and Steel Products
B. ASTM A143-74 Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
C. ASTM A153-82 Zinc Coating (hot-dip) on Iron and Steel Hardware
D. ASTM A384-76 Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
E. ASTM A385-80 Providing High-Quality Zinc Coatings (hot-dip)
F. ASTM A780-80 Repair of Damaged Hot-Dip Galvanized Coatings
G. MILSPEC DOD-P-21035-78 Paint, High Zinc Dust Content, Galvanizing Repair

1.04 SUBMITTALS

A. Manufacturer's product data showing conformance to specified product.
B. Manufacturer's recommendation for application of zinc dust-zinc oxide coating.
C. Coating applicator's Certificate of Compliance that the hot-dip galvanized coating meets or exceeds the specified requirements.

1.05 QUALITY ASSURANCE

A. Coating systems to protect components from corrosion and other environmental degradation. System shall result in a consistent product in quality and appearance.

1.06 DELIVERY, STORAGE AND HANDLING

A. Manufactured materials shall be delivered in original, unbroken packages bearing the label of the manufacturer.
B. All materials shall be carefully stored in a manner that will prevent damage and in an area that is protected from the elements.
PART 2  PRODUCTS

2.01 Zinc Oxide Coating Systems
   A. Zinc coating material shall be as specified in ASTM A153.
   B. Zinc dust-zinc oxide coating shall conform to MILSPEC DOD-P-21035. Coating shall be as manufactured by Z. R. C. Chemical Products, Galvicon Company or approved equal.
   C. Coating weights shall conform to ASTM A123 or Table 1 of ASTM A153, as appropriate.

PART 3  EXECUTION

3.01 WORKMANSHIP
   A. Steel members, fabrications and assemblies shall be galvanized after fabrication in accordance with ASTM A123.
   B. Anchor bolts and nuts shall be stainless steel unless noted otherwise.
   C. Where zinc coating has been damaged after installation, substrate surface shall be first cleaned and then repaired with zinc dust-zinc oxide coating in accordance with ASTM A780. Coating shall consist of multiple coats to dry film thickness of eight (8) mils.
   D. Items not physically damaged, but which have insufficient or deteriorating zinc coatings, and items damaged in shipment or prior to installation, shall be removed from the project site for repair by the hot-dip zinc coating method.

PART 4  SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT
   A. Payment for Hot-Dip Zinc Coating in the Section shall be included within the lump sum basis for the amount stated on the Bid Form for the Project. No separate measurement or payment will be made for these quantities and items.
   B. Payment for Hot-Dip Zinc Coating in this Section shall be included within the respective unit prices for each type of pipe, manholes, services and associated appurtenance items. No separate measurement or payment will be made for these quantities and items.

END OF SECTION
SECTION 05090 – ANCHOR BOLTS AND FASTENERS

PART 1  GENERAL

1.01 WORK INCLUDED
   A. This section shall include furnishing and installing anchor bolts, screws, and other fasteners, complete with washers and nuts as shown on the Plans or specified or as required for proper anchorage of equipment and materials.

1.02 DESIGN REQUIREMENTS
   A. Fasteners and bolts shall have sufficient strength for the intended location and use. Equipment anchorage fasteners shall be included in a code approved published report (ie. ICBO Evaluation Report, or ICC ER) showing tested strength values and compliance with current IBC.

1.03 REFERENCES
   B. ASTM A36/A36M-89  Structural Steel
   C. ASTM A307-90  Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
   D. ASTM A320-A320M-88  Alloy-Steel Bolting Materials for Low Temperature Service
   F. ICBO  International Conference of Building Officials

1.04 SUBMITTALS
   A. Manufacturer’s product data showing conformance to specified product requirements.
   B. Data indicating load capacities, chemical resistance, and temperature limitations.
   C. Installation instructions
   D. Evaluation report from ICC-ES for the particular brand of anchors to be used showing load capacities and compliance with the 2006 IBC.

PART 2  PRODUCTS

2.01 General
   A. All anchor bolts and fasteners shall be stainless steel unless noted otherwise.
   C. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 15 percent, up to a limiting maximum oversizing of 1/8-inch. Unless otherwise specified, or shown in the drawings, minimum anchor bolt diameter shall be ½ inch.
D. Tapered washers shall be provided where mating surface is not square with the nut. Flat washers required all other places. Nuts and washers shall be same material as bolts.

2.02 Bolts, Nuts, Washers

A. Bolts. ASTM A320, Type 304 or 316, Stainless Steel, B8 or B8M Class 1 or 2

B. Nuts and Washers. ASTM A194, Grade 8, 304 or 316 stainless steel.

2.03 Wedge-Type Mechanical Anchor Bolts (Into Solid Concrete)

A. Wedge anchors shall have a stainless steel split expansion ring and a threaded stud bolt body and integral cone expander, nut and washer. Anchor bodies, nuts, and washers shall be type 304 or 316 stainless steel.

B. The exposed end of the anchor shall be stamped to identify anchor length. Stampings should be preserved during installation for any subsequent embedment verification.

C. Anchors shall be tested to ASTM E488 criteria and listed by ICC (formerly ICBO).

D. Approved products include: ITW Red Head Trubolt; Hilti Kwik Bolt 3; or approved equal.

2.04 Sleeve-Type Mechanical Anchor Bolts (Into Hollow Concrete Block)

A. Sleeve type anchors with split expansion sleeve over a threaded stud bolt body and integral expander, nut and washer. Anchor bodies, nuts, and washers shall be type 304, 316, or 18-8 stainless steel.

B. The exposed end of the anchor shall be stamped to identify anchor length. Stampings should be preserved during installation for any subsequent embedment verification.

C. Anchors shall be tested to ASTM E488 criteria and listed by ICC (formerly ICBO).

D. Approved products include: ITW Red Head Dynabolt; Hilti HLC Sleeve Anchor; or approved equal.

2.05 Adhesive Anchor Bolts

A. Threaded Rod. ASTM F-593 CW stainless steel threaded rod, type 304 or 316. Nuts shall be stainless steel conforming to ASTM F-594. Washers shall be stainless steel conforming to ASTM A-240, AISA 304, and ANSI B18.22.1. Rod to have a minimum yield strength \( f_y \) of 65,000 psi in 3/8” to 5/8” diameter and 45,000 psi in 3/4” to 1-1/4” diameter.

B. Where exposed to potable water (tank interiors, etc.), adhesive shall be listed as compliant with NSF/ANSI Standard 61.

D. Approved products include: Threaded Rod – Hilti HAS Stainless Steel or approved equal; Adhesives – ITW Red Head C6; Hilti HIT RE 500; or approved equal.

2.06 Lag Bolts/Screws
A. Hex head 18-8 or 304 stainless steel with washers.

2.07 Toggle Bolts
A. Use only where lag screws cannot be secured to wood wall studs.

2.08 Nails
A. All nails used shall be hot-dip galvanized.

PART 3 EXECUTION

3.01 WORKMANSHIP
A. Expansion, wedge or adhesive anchors set in holes drilled in the concrete after the concrete is placed will not be permitted in substitution for cast-in-place anchor bolts except where otherwise specified. Upset threads shall not be acceptable.

B. Fieldwork, including cutting and threading, shall not be permitted on galvanized items. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or phenolic washers.

C. Use carbide tipped hammer drill bits made in accordance to ANSI B212.15-1994 to install anchors.

D. Cast In-Place Anchor Bolts
1. Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if specified, recesses or blockouts shall be formed in the concrete and the metalwork shall be grouted in place.

2. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

E. Adhesive Anchor Bolts
1. Use of adhesive or capsule anchors shall be subject to the following conditions:
   a. Use shall be limited to locations where exposure, on an intermittent or continuous basis, to acid concentrations higher than 10 percent, or to machine or diesel oils, is extremely unlikely.
   b. Use shall be limited to applications where exposure to fire or exposure to concrete or rod temperature above 120 degrees F. is extremely unlikely. Overhead applications (such as pipe supports) because of the above concerns, shall be disallowed.
   c. Approval from Engineer for specific application and from supplier of equipment to be anchored, if applicable.
d. Anchor diameter and grade of steel shall be per Contract Documents or per equipment supplier specifications. Anchor shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease and oils.

e. Embedment depth shall be as specified. Adhesive capsules of different diameters may be used to obtain proper volume for the embedment, but no more than two (2) capsules per anchor may be used. When installing different diameter capsules in the same hole, the larger diameter capsule shall be installed first. Any extension or protrusion of the capsule from the hole is prohibited.

f. All installation recommendations by the anchor system manufacturer shall be followed carefully, including maximum hole diameter.

g. Holes shall have rough surfaces, such as can be achieved using a rotary percussion drill.

h. Holes shall be blown clean with compressed air and be free of dust or standing water prior to installation.

i. Anchor shall be left undisturbed and unloaded for full adhesive curing period.

j. Concrete temperature (not air temperature) shall be compatible with curing requirements of adhesives per adhesive manufacturer.

F. Expansion Anchors

1. Use of expansion or wedge type anchors shall be subject to same conditions in as epoxy (adhesive) anchors as applicable.

**PART 4 SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Payment for Anchor Bolts and Fasteners in the Section shall be included within the lump sum basis for the amount stated on the Bid Form for the Project. No separate measurement or payment will be made for these quantities and items.

B. Payment for Anchor Bolts and Fasteners in this Section shall be included within the respective unit prices for each type of pipe, manholes, services and associated appurtenance items. No separate measurement or payment will be made for these quantities and items.

END OF SECTION
PART 1  GENERAL

1.01 SECTION INCLUDES

A. Continuous slot, bolted metal framing channels and all associated fittings and hardware.
B. Trapeze type supports for cable tray, conduit, pipe and other similar systems.
C. Use of bolted metal framing as a surface metal raceway.

1.02 REFERENCES

A. ASTM A123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
B. ASTM A653 - General Requirements for Steel Sheet, Zinc-Coated Galvanized by the Hot-Dip Process
C. ASTM A1011 - Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability (Formerly ASTM A570)
E. ASTM A907 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled, Structural Quality
F. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel
G. MFMA - Metal Framing Manufactureres Association
H. ANSI/NFPA 70– National Fire Protection Association (National Electrical Code)
I. AISI - American Iron and Steel Institute

1.03 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in the manufacture of bolted metal framing of the types required, whose products have been in satisfactory use in similar service for not less than 5 years.
B. MFMA Compliance: Comply with the latest revision of MFMA Standards Publication Number MFMA-3, "Metal Framing Standards Publication".
C. NEC Compliance: Comply with the latest revision NFPA 70 - Article 352 "Surface Metal Raceways and Surface Nonmetallic Raceways".
E. Bolted framing channels and fittings shall have the manufacturers name, part number, and material heat code identification number stamped in the part itself for identification.
Material certification sheets and test reports must be made available by the manufacturer upon request.

F. Stainless steel bolted framing parts shall be stamped to identify the material. Material certification sheets and test reports must be made available by the manufacturer upon request.

1.04 SUBMITTALS

A. Submit drawings of strut and accessories including clamps, brackets, hanger rods, and fittings.

B. Submit manufacturer's product data on strut channels including, but not limited to, types, materials, finishes, gauge thickness, and hole patterns. For each different strut cross-section, submit cross-sectional properties including Section Modulus \( (S_X) \) and Moment of Inertia \( (I_X) \).

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver strut systems and components carefully to avoid breakage, denting, and scoring finishes. Do not install damaged equipment.

B. Store strut systems and components in original cartons and in clean dry space; protect from weather and construction traffic.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with these specifications, strut systems to be installed shall be as manufactured by Cooper B-Line, Inc.; Unistrut; or engineer approved equal.

2.02 STRUT CHANNELS AND COMPONENTS

A. General: Strut shall be 1-5/8 x 1-5/8 inches x 12 gauge in varying heights and welded combinations as required to meet load capacities and designs indicated on the drawings.

B. Materials and Finish: Material and finish specifications shall meet one of the following:

1. Epoxy Painted: Strut shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS Grade 33, then painted with green water born epoxy applied by a cathodic electro-deposition process. Fittings shall be manufactured from steel meeting the minimum requirements of ASTM A907 SS, Grade 33, and epoxy painted or hot-dip galvanized. All hardware shall be stainless steel Type 304 or Type 316.

2. Hot-dip Galvanized Steel: Strut shall be made from steel meeting the minimum mechanical properties of ASTM A1011 SS, Grade 33 and shall be hot-dip galvanized after fabrication in accordance with ASTM A123. Fittings shall be manufactured from steel meeting the minimum requirements of ASTM A907 SS, Grade 33, and hot-dip galvanized after fabrication in accordance with ASTM A123. All hardware shall be stainless steel Type 304 or Type 316. All hot-dip galvanized after fabrication products must be returned to point of manufacture after coating for inspection and removal of all sharp burrs.
3. Stainless Steel: All strut, fittings and hardware shall be made of AISI Type 304 or type 316 stainless steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install strut in accordance with MFMA-102 ‘Guidelines for the Use of Metal Framing’; in accordance with equipment manufacturer’s recommendations, and with recognized industry practices.

B. All nuts and bolts shall be tightened to the following values or as recommended by manufacturer.

<table>
<thead>
<tr>
<th>Bolt Size</th>
<th>Torque (ft-lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 - 20</td>
<td>6</td>
</tr>
<tr>
<td>5/16 - 18</td>
<td>11</td>
</tr>
<tr>
<td>3/8 - 16</td>
<td>19</td>
</tr>
<tr>
<td>1/2 - 13</td>
<td>50</td>
</tr>
</tbody>
</table>

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Slotted Channel Framing and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
# DIVISION 6- WOOD
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<td>ROUGH CARPENTRY</td>
</tr>
<tr>
<td>SECTION 06173</td>
<td>WOOD TRUSSES</td>
</tr>
</tbody>
</table>
SECTION 06100 – ROUGH CARPENTRY

PART 1    GENERAL

1.01 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The most recently issued codes and publications shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)


APA - THE ENGINEERED WOOD ASSOCIATION (APA)


AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)


ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts

AMERICAN WOOD-PRESERVERS’ ASSOCIATION (AWPA)

AWPA C1 (1996) All Timber Products – Preservative Treatment by Pressure Processes

AWPA C2 (1996) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes

AWPA C9 (1996) Plywood - Preservative Treatment by Pressure Processes

AWPA M2 (1996) Inspection of Treated Wood Products

AWPA M6 (1996) Brands Used on Forest Products

FEDERAL SPECIFICATIONS (FS)

FS FF-B-588 (Rev. E) Bolt, Toggle: and Expansion Sleeve, Screw

FS FF-N-105 (Rev. B) (Int Amd. 4) Nails, Brads, Staples and Spikes: Wire, Cut and Wrought

FS FF-S-325 (Int Amd. 3) Shield, Expansion, Nail Expansion, and Nail, Drive Screw (Devices, Anchoring, Masonry)

FS FF-W-92 Flat Washers

OREGON STRUCTURAL SPECIALTY CODE (OSSC)
1.02 SUBMITTALS

A. The following shall be submitted in accordance with Section 01300, Submittals:

1. SD-07, Certificates – Certificates of grade

2. SD-11, Factory Test Reports – Preservative-treated lumber and plywood

1.03 DELIVERY AND STORAGE

A. Deliver materials to the site in an undamaged condition.

B. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness.

C. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Remove defective and damaged materials and provide new materials.

1.04 GRADING AND MARKING

A. Lumber – Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used.

B. Plywood – Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The
mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with PS-1.

C. Preservative-Treated Lumber and Plywood – The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The AWPB Quality Mark “LP-2” or LP-22” on each piece also will be accepted as evidence of compliance with applicable AWPA treatment standards.

1.05 SIZES AND SURFACING

A. Comply with PS-20 for dressed sizes of yard lumber. Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

1.06 MOISTURE CONTENT

A. Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:

1. Framing lumber and boards - 19 percent maximum
2. Materials other than lumber - Moisture content shall be in accordance with standard under which the product is produced

1.07 PRESERVATIVE TREATMENT

A. Treat lumber and timber in accordance with AWPA C1 and AWPA C2, and plywood in accordance with AWPA C1 and AWPA C9. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Do not incise surfaces of lumber that will be exposed. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. The following items shall be preservative treated:

1. Wood framing, blocking, and plywood
2. Wood sills, soles, plates, furring, and sleepers, furring and nailers that are set into or in contact with concrete or masonry.
3. Nailers, edge strips, crickets, curbs, and cants for roof decks.

1.08 QUALITY ASSURANCE

A. Certificates of Grade – Submit certificates attesting that products meet the grade requirements specified in lieu of grade markings where appearance is important and grade marks will deface material.

PART 2 PRODUCTS

2.01 WOOD MATERIALS

A. Framing lumber, cant strips, sleepers, furring, sub-fascias, nailing strips, and nailers and board lumber such as subflooring and wall and roof sheathing shall be one of the species listed in the table below. Minimum grade of species shall be as listed.
B. Table of Grades for Framing and Board Lumber

<table>
<thead>
<tr>
<th>Grading Rules</th>
<th>Species</th>
<th>Framing</th>
<th>Board Lumber</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWPA WLGR</td>
<td>Douglas Fir-Larch</td>
<td>All Species:</td>
<td>All Species:</td>
</tr>
<tr>
<td>Standard grading rules</td>
<td>Douglas Fir South Hem-Fir</td>
<td>Standard Light Framing or No. 3</td>
<td>No. 3 Common</td>
</tr>
<tr>
<td></td>
<td>Hem-Fir</td>
<td>Structural Light Framing 2x4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ponderosa Pine – Sugar</td>
<td>nominal size, (Stud Grade for 10-ft</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pine</td>
<td>and shorter)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subalpine Fir</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>White Woods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WCLIB 17</td>
<td>Douglas Fir-Larch</td>
<td>All Species:</td>
<td>All Species:</td>
</tr>
<tr>
<td>Standard grading rules</td>
<td>Hem-Fir</td>
<td>Standard Light or No. 3 Structural</td>
<td>Standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Light Framing (Stud Grade for 2x4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>nominal size, 10-ft and shorter)</td>
<td></td>
</tr>
</tbody>
</table>

C. Plywood Sheathing – Unless specified otherwise, Plywood sheathing shall be tongue-and-groove exterior grade sheathing, 5/8-inch minimum thickness, grade stamped "C-C Ext-DFPA," and manufactured in accordance with NIST PS 1, Group 1.

2.02 ANCHORAGE AND FASTENER MATERIALS

A. Nails and Staples – Nails, staples, and tacks shall conform to FS FF-N-105. Nails for fastening interior wood partitions or rough framing shall be steel wire nails. Nails for roof blocking, cants, and nailers shall be galvanized. Nails used to fasten exposed wood fascias or finished wood members exposed to the weather shall be aluminum alloy or galvanized finishing nails. Power-driven staples shall be galvanized Type III, Style 3.

B. Bolts, Nuts and Screws – Bolts, including non-headed anchor bolts, shall be carbon steel, galvanized, conforming to ASTM A307, Grade A. Nuts shall be carbon steel, galvanized, conforming to ASTM A563. Wood screws shall be carbon steel, galvanized, conforming to ANSI B18.6.1. Expansion shields, expansion nails, and drive screw devices shall conform to FS FF-S-325. Toggle bolts shall conform to FS FF-B-588. Washers shall be carbon steel, galvanized, general assembly purpose type, conforming to FS FF-W-92, Type A, Grade I, Class A.

C. Bar or Strap Anchors – Bar or strap anchors shall be steel conforming to ASTM A36/A36M. Hot-dip galvanized coating shall be in accordance with ASTM A525, G90.

PART 3 EXECUTION

3.01 INSTALLATION

A. General – Members shall be framed for the passage of ducts and pipes and shall not be cut, notched, or bored more than one quarter of their depth without approved reinforcement. Washers shall be provided under bolt heads or nuts in contact with wood. Lumber shall be bored to receive bolts. Nailers, blocking, and furring shall be furnished in lengths that minimize joints.
B. Interior Wood Partitions – Wood partitions shall be framed with 2x4 studs spaced 16 inches on center, unless otherwise indicated. Framing shall be closely fitted, accurately constructed to true plane lines and levels, and rigidly secured in place in conformance with NFOPA-03. Partition plates shall be secured to concrete floor with anchor bolts, expansion sleeves, and lag bolts. Powder-driven fasteners may be used. One anchor shall be provided near each end of the partition plate and at intermediate intervals at a maximum spacing of 4 feet on center. Studs shall be doubled at openings. Headers shall consist of two pieces of nominal 2-inch framing lumber set on edge and nailed together. Depth of header shall be determined in accordance with the NFOPA-03, except that the span for a header of two 2x4’s shall not exceed 3 feet. Corners shall be constructed of not less than three studs. End studs of partitions abutting concrete or masonry shall be anchored thereto with 1/2-inch expansion bolts, one near each end and at intermediate maximum intervals of 4 feet, or with powder-driven threaded fasteners, same size and spacing. Rough wood bucks and frames shall be anchored to masonry and concrete with 3/16-inch by 1-1/4-inch steel straps, turned up 2 inches at ends and extending not less than 3 inches into concrete masonry units or concrete. Anchors shall be placed near top and bottom of each buck and frame and at intermediate intervals of 3-feet maximum. Partitions shall have top plates and single bottom plate with one continuous row of horizontal wood blocking the full width of the partition, wedged and nailed in place at mid-height. Partitions shall be framed for the installation of the facing material, trim, cabinets, plumbing, and other work. Blocking and nailers, of not less than 1x4 stock, shall be cut to fit horizontally and vertically between framing and nailed thereto to receive finished wall material. Solid blocking shall be provided at locations required for installation of wall-mounted cabinets, shelves, fixtures, and equipment.

C. Blocking, Cant Strips, and Nailers – Nailing strips, blocking, cant strips, and sub fascia wood members shall be continuous, cut with square ends and in maximum practical lengths. For bolted connections, sub-fascia members shall be fastened to concrete or concrete masonry units with 1/2-inch bolts at a maximum spacing of 4 feet on center, one bolt near each end of the member. Bolt heads shall be countersunk flush with the surface of the wood. Sub-fascia members shall be held to a tolerance of 1/8 inch in 10 feet. Wood cant strips shall be not less than 4-inches long and set at projections through the roof deck, expansion joints, and fascias. Perimeter roof blocking shall have screened holes providing a net open area equivalent to at least 10 percent of the edge face to provide ventilation for insulation.

D. Wood Furring – Furring strips shall be erected plumb and rigid, using wood shims wherever necessary to adjust the face of the furring to a true, even plane to receive finish materials. Exterior masonry walls shall be furred to receive or dry-wall finish. Furring shall be 1x3 continuous strips, 16 inches on center, installed vertically. Furring shall be secured to concrete with nailing plugs, clips, or masonry nails. Fasteners shall be provided at top and bottom and at 24 inches on center, minimum. Furring strips fastened to concrete masonry units shall be secured by toggle bolts, anchor bolts, or screw expansion sleeves.

E. Wood Sheathing – Plywood sheathing shall be of indicated thickness and installed in accordance with APA E30. Nailing shall conform to the nailing schedule per OSSC Chapter 23, unless otherwise shown on the drawings.
PART 4     SPECIAL PROVISIONS

4.01    MEASUREMENT AND PAYMENT

A. Payment for Rough Carpentry and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 06173 – WOOD TRUSSES

PART 1  GENERAL

1.01  WORK INCLUDED

A. This section includes all work associated with furnishing and placing prefabricated metal-plate-connected wood trusses as shown on the drawings and as indicated by the requirements of this section.

1.02  RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.

1.03  RELATED SECTIONS

A. Section 06100 – Rough Carpentry

1.04  DESIGN CRITERIA

A. Trusses should be capable of withstanding design loads indicated without exceeding ANSI/TPI 1 deflection limits.

1.  Where gypsum board ceilings are hung directly from trusses, limit live load deflection to 1/360th of span.

1.05  QUALITY ASSURANCE AND REGULATORY REQUIREMENTS

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with TPI quality-control procedures for manufacture of connector plates published in TPI 1.

1. Manufacturer’s responsibilities include preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that involves inspection by SPIB, Timber Products Inspection, TPI, or other independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.


1.06  SUBMITTALS

A. Submit Product Data: For metal-plate connectors, metal framing anchors, bolts, and fasteners indicated.

B. Submit Shop Drawings: Show location, pitch, span, camber, configuration, and spacing for each type of truss required; species, sizes, and stress grades of lumber; splice details;
type, size, material, finish, design values, orientation, and location of metal connector plates; and bearing details.

1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Submit Qualification Data for the following:

1. Metal-plate manufacturer.
2. Fabricator.

D. Research/Evaluation Reports for the following:

1. Metal-plate connectors.
2. Metal framing anchors.

1.07 DELIVERY AND STORAGE

A. Store trusses on job site in accordance with manufacturer's instructions. Provide bearing supports and bracings to prevent bending or overturning of trusses during transit and storage.

PART 2 PRODUCTS

2.01 DIMENSION LUMBER

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

B. Grade and Species: Any species for truss chord and web members, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AFPA's "National Design Specifications for Wood Construction" and its "Supplement."

2.02 METAL PRODUCTS

A. Metal Connector Plates: Fabricate connector plates to comply with ANSI/TP1 1 from hot-dip galvanized steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation; Designation SS, Grade 33, and not less than 0.036 inch (0.9 mm) thick.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Alpine Engineered Products, Inc.
b. CompuTrus, Inc.
c. Eagle Metal Products.
d. Jager Industries, Inc.
e. Mitek Industries, Inc.
g. TEE-LOK Corporation.
h. Truswal Systems Corporation.
B. Fasteners: Where trusses are exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

4. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M).
5. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

C. Metal Framing Anchors: Provide framing anchors made from hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Alpine Engineered Products, Inc.
   b. Cleveland Steel Specialty Co.
   c. Harlen Metal Products, Inc.
   d. KC Metals Products, Inc.
   e. Silver Metal Products, Inc.
   f. Simpson Strong-Tie Company, Inc.
   g. Southeastern Metals Manufacturing Co., Inc.
   h. United Steel Products Company, Inc.

2. Allowable Design Loads: Meet or exceed those indicated per manufacturer's published values determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.03 FABRICATION

A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Lifting points, as indicated, shall be used to hoist trusses into position. Exercise care to prevent out-of-plane bending of trusses.

B. Install and brace trusses according to ANSI/TPI 1 recommendations and as indicated. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

C. Anchor trusses securely at bearing points; use metal framing anchors. Install fasteners through each fastener hole in metal framing anchor according to manufacturer's fastening schedules and written instructions.
D. Securely connect each truss ply required for forming built-up girder trusses. Anchor trusses to girder trusses as indicated.

E. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
   1. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

F. Install wood trusses within installation tolerances of ANSI/TPI 1.

G. Do not cut or remove truss members.

H. Return wood trusses that are damaged or do not meet requirements to fabricator and replace with trusses that do meet requirements.

**PART 4 SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Payment for Wood Trusses and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
# DIVISION 7- THERMAL AND MOISTURE PROTECTION
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<td>JOINT SEALANTS</td>
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SECTION 07210 - BUILDING INSULATION

PART 1  GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and Division 1 specification sections, apply to work of this section.

1.02 DESCRIPTION OF WORK

A. This Section includes the following:

1. Building insulation in batt and rigid form.

1.03 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide insulation materials, for types of conditions listed, which are identical to those whose fire performance characteristics have been determined per the ASTM test method indicated below, by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

B. Surface burning characteristics: As follows, tested per ASTM E 84 and current building code standards.

1. When insulation facing is not in substantial contact with the surface of ceiling or wall board: Flame spread to be 25 or less and smoke density to be 450 or less.

2. When insulation facing is in substantial contact with surface of ceiling or wall board: Contact spread and smoke density may be non-rated.

C. Single Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work.

1.04 DELIVERY, STORAGE AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling and other sources. Store inside and in a dry location. Comply with manufacturer's recommendations for handling, storage and protection during installation.

PART 2  PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide insulation products of one of the following:

B. Manufacturers of Glass Fiber Insulation:

1. CertainTeed Corp.

3. Owens/Corning Fiberglas Corp.

4. or approved equal.

C. Manufacturer of Rigid Insulation:

1. Contractor's option.

2.02 INSULATING MATERIALS

A. General: Provide insulating materials that comply with requirements and with referenced standards.

B. Preformed Units: Sizes to fit applications indicated, selected from manufacturer's standard thicknesses, widths and lengths.

C. Glass Fiber Blanket/Batt Insulation: Inorganic glass fibers formed into resilient flexible blankets or semi-rigid batts; FS HH-I-521, Type as indicated, densities of not less than 0.5 lb. per cu. ft. for glass fiber units, k-value of 0.27; manufacturer's standard lengths and widths as required to coordinate with spaces to be insulated; types as follows:

D. Non-reflective vapor barrier faced units or FS-25 foil reinforced faced units with integral nailing flanges; barrier rating of 1.0 perms, other face (if any) permeable.

E. Rigid Insulation: Extruded polystyrene plastic board insulation. Rigid closed cell expanded polystyrene insulation board with integral high density skin; complying with F.S.-HH-1-523; Type II, Class B, minimum 18 psi compressive strength; lc value of .20; 5% maximum water absorption; manufacturer's standard width and lengths, thickness as indicated or required to fill void.

F. Mechanical Anchors: Type and size as recommended by insulation manufacturer for type of application and condition of substrate.

G. Insulation Baffles: Provide and install insulation baffles at top of walls as necessary to maintain required ventilation area in each joist and truss space.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions affecting performance of insulation. Notify Contractor in writing of unsatisfactory conditions. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor barriers, including removal of projections that might puncture vapor barriers.

3.03 INSTALLATION, GENERAL
A. Comply with insulation manufacturer's instructions applicable to products and application indicated. If printed instructions are not available or do not apply to project conditions, consult manufacturer's technical representative for specific recommendations before proceeding with installation of insulation.

B. Extend insulation full thickness as indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.

C. Apply a single layer of insulation of required thickness, unless otherwise shown or required to make up total thickness.

D. Do not install insulation until insulation can be maintained dry.

3.04 INSTALLATION OF BATT INSULATION

A. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations. If no specific method is indicated, use mechanical anchorage to provide permanent placement and support of units. Friction fit of sound batts not approved.

B. Set vapor barrier faced units with vapor barrier to heated side of construction.

C. Tape joints and ruptures in vapor barrier and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

D. Set reflective, foil-faced units accurately with not less than 0.75 inch air space in front of foil as indicated.

E. Stuff glass fiber insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume (to a density of approximately 2.5 pcf).

F. Blanket-Type Building Insulation:
   1. R-38 in ceiling spaces.
   2. R-23 in wall spaces and above foundation walls.
   3. 3½” sound batts at locations indicated on plan.

3.05 INSTALLATION OF RIGID INSULATION

A. Locate at block walls at locations indicated. Secure in place.

B. Rigid Insulation:
   1. 2” thick, at interior of block walls.

3.06 PROTECTION

A. General: Protect installed insulation and vapor barriers from damage due to harmful weather exposures, physical abuse and other causes. Provide temporary coverings or enclosures where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
PART 4    EXECUTION

4.01 MEASUREMENT AND PAYMENT

A. Payment for Building Insulation and other work in this section shall be a portion of the on a lump sum price for the Control Building as stated on the bid form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 07410 - METAL ROOF PANELS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Factory-formed Standing seam metal roofing. Metal roofing system includes:
   1. Snap-On Standing Seam Panels
   2. Ridge Vents
   3. All related flashing, clips, and accessories as required for complete system

B. Related Sections: Section(s) related to this section include:
   1. Joint Sealants: Section 07920.
   2. Gutters and downspouts: Section 07715.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. Underwriters Laboratories, Inc. (UL):
   2. UL 580 Tests for Uplift Resistance of Roof Assemblies.

C. Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA):

1.03 SYSTEM DESCRIPTION

A. Performance Requirements: Provide sheet metal roofing which has been manufactured, fabricated and installed to withstand structural and thermal movement, wind loading and weather exposure to maintain manufacturer’s performance criteria without defects, damage or failure of infiltration of water.

   1. Wind-Uplift: Roof panel assembly shall comply with UL 580 for UL 90 rated assemblies.
2. Static Air Infiltration: Completed roof system shall have a maximum of 0.06 cfm/sf with 6.24 psf (299 Pa) air pressure differential as per ASTM E283.

3. Water Infiltration: No evidence of water penetration at an inward static air pressure differential of not less than 6.24 psf (299 Pa) and not more than 12 psf (575 Pa) as per ASTM E331.

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit product data, including manufacturer’s SPEC-DATA® product sheet, for specified products.

C. Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors and textures.

D. Samples: Submit selection and verification samples for finishes, colors and textures. Color to be selected by Owner from manufacturer’s standard color selection.

E. Quality Assurance Submittals: Submit the following:
   1. Certificates: Product certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical requirements.
   2. Manufacturer’s Instructions: Manufacturer’s installation instructions.

F. Closeout Submittals: Submit the following:
   1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals, Maintenance Data and Operation Data Section. Include methods for maintaining installed products, precautions against cleaning materials and methods detrimental to finishes and performance.
   2. Warranty: Warranty documents specified herein.
   3. Record Documents: Project record documents for installed materials in accordance with Division 1 Closeout Submittals (Project Record Documents) Section.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall be experienced in performing work of this section and should have specialized in the installation of work similar to that required for this project.
   1. Installer shall have successfully completed at least three (3) installations.


C. Preinstallation Meetings: Conduct preinstallation meeting to verify project requirements, substrate conditions, manufacturer’s installation instructions and manufacturer’s warranty requirements.

1.06 DELIVERY, STORAGE & HANDLING
A. General: Comply with Division 1 Product Requirements Sections.

   1. Ordering: Comply with manufacturer’s ordering instructions and lead time requirements to avoid construction delays.

B. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact. Identify fabricated components with UL 90 label where appropriate.

C. Storage and Protection: Store materials protected from exposure to harmful conditions. Store material in dry, above-ground location.

   1. Stack prefinished material to prevent twisting, bending, abrasion, scratching and denting. Elevate one end of each skid to allow for moisture runoff.
   2. Prevent contact with material that may cause corrosion, discoloration or staining.
   3. Do not expose to direct sunlight or extreme heat trim material with factory applied strippable film.
   4. Damaged material shall be replaced prior to installation.

1.07 PROJECT CONDITIONS

A. Field Measurements: Verify actual measurements and openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

1.08 WARRANTY

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty document executed by authorized company official. Manufacturer’s warranty is in addition to, and not a limitation of, other rights Owner may have under the Contract Documents.

B. Warranty Required: 20-year non-prorated warranty covering material finish, including color, fade, chalking and film integrity. Commences on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SHEET METAL ROOFING

A. Manufacturer: Petersen Aluminum Corporation or engineer approved equal.

   1. Contact: 1005 Tonne Road, Elk Grove Village, IL 60007; Telephone: (800) 323-1960, (847) 228-7150; Fax: (800) 722-7150; website: www.pac-clad.com.

B. PAC-CLAD Snap-On Panels:

   1. Type: Standing Seam.
   2. Seam Height: 1" Seam Height or 1 1/2" Seam Height.
   4. Panel Dimension: 12" to 18" oc.
   5. Texture: Smooth texture.
6. Rating: UL 90 rating (Wind uplift) panel assembly.

7. Flashing and Trim: HDG Steel, 22 gauge.


C. PAC-CLAD Flashing and Trim: Manufacturer’s standard flashing and trim profiles, factory formed, gauge as recommended by manufacturer, color and finish to match metal roofing panels.

D. Substitutions: May be considered when quality and warranty are equal to specified product. Submit for approval in timely manner to avoid delays. Coordinate with Division 1.

2.02 MATERIALS

A. Galvanized Steel Sheet: ASTM A653, G90 steel sheet, zinc coated (galvanized) by hot dip process, structural quality.

1. Thickness: 24 gauge and 22 gauge as indicated.

2.03 RELATED MATERIALS

A. General: Coordinate use of related materials:

1. Underlayment: ASTM D226, Type II No. 30 asphalt saturated organic roofing felt. Two layers required. Alternative roofing materials may require a different underlayment to meet warranty.

2. Plywood Deck: 5/8" nominal thickness, exterior grade.


2.04 FABRICATION

A. General:

1. Continuous Length: Fabricate panels 40’ and less in one continuous length.

2. Trim and Flashings: Fabricate trim and flashings from same material as roof system material.

3. Portable Roll Former: Panels fabricated by portable roll former shall not be approved.

2.05 FINISHES

A. PAC-CLAD Factory Applied Finish:

1. Topside: Full-strength fluoropolymer (70% Kynar 500 or Hylar 5000 resin) system of 1.0 mil total dry film thickness.

2. Underside: Wash coat of 0.3 – 0.4 mil (0.008 – 0.010 mm) dry film thickness.

3. Texture: Smooth texture, dull matte specular gloss 25% – 35% at 60°.

4. Protective Film: Strippable vinyl film applied during panel fabrication and finishing.

B. COLORS
1. Submit manufacturer’s color selection samples. At least 10 colors shall be available.

2. Color will be selected by Owner.

2.06 SOURCE QUALITY

A. Source Quality: Obtain sheet metal roofing from a single manufacturer.

PART 3 EXECUTION

3.01 MANUFACTURER’S INSTRUCTIONS

A. Compliance: Comply with manufacturer’s product data, recommendations and installations instructions for substrate verification, preparation requirements and installation.

1. Strippable Film: Remove manufacturer’s protective film, if any, from surfaces of roofing panels.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer’s instructions.

3.03 PREPARATION

A. Coordination: Coordinate metal roofing with other Work (drainage, flashing and trim, deck substrates, parapets, copings, walls) and other adjoining work to provide a noncorrosive and leakproof installation.

B. Dissimilar Metals: Prevent galvanic action of dissimilar metals.

3.04 INSTALLATION

A. General: Install metal roofing panels to profiles, patterns and drainage indicated and required for leakproof installation. Provide for structural and thermal movement of work. Seal joints for leakproof installation.

1. Seams: Provide uniform, neat seams.

2. Fasteners: Conceal fasteners in exposed work. Cover and seal fasteners and anchors for watertight and leakproof installation.

3. Sealant-Type Joints: Provide sealant-type joint where indicated. Form joints to conceal sealant. Comply with Division 7 Joint Sealants Section for sealant installation.

3.05 FIELD QUALITY REQUIREMENTS

A. Site Tests (Post-Installation Testing): Owner reserves right to perform post-installation testing of installed sheet metal roofing.

3.06 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Replace damaged
installed products. Clean installed products in accordance with manufacturer’s instructions prior to Owner’s acceptance. Remove construction debris from project site and legally dispose of debris.

3.07 PROTECTION

A. Protection: Protect installed product from damage during construction.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Metal Roof Panels and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 07715 – ALUMINUM GUTTERS AND DOWNSPOUTS

PART 1  GENERAL

1.01  SUMMARY
   A. Section includes aluminum gutters, downspouts, drop outlets, elbows, end caps, miters, supports, straps, and other accessories and finish for a complete system.
   B. Also included: Installation and testing.

1.02  REFERENCES

1.03  SYSTEM DESCRIPTION
   A. Downspouts at locations as shown on the Plans. Provide all necessary downspout straps and other items for a complete installation. System shall be free from leaks.

1.04  SUBMITTALS
   A. Prior to ordering, submit manufacturer’s data for approval. Include material compliance information, coating system, warranty, and finish.
   B. Submit manufacturer’s color samples for approval by City Engineer in accordance with Section 09900- Paint and Coatings.

PART 2  PRODUCTS

2.01  MATERIAL
   A. Downspout shall be produced from 3105 H26P aluminum sheet with a minimum tensile strength of 29,000 psi and minimum yield strength of 25,000 psi.
      1. Downspout, Downspout Strap, and Elbow Thickness: 0.027-inch minimum

2.02  SIZE AND STYLE
   A. Downspouts shall be 2-inch by 3-inch rectangular corrugated.

2.03  FINISH
   A. Both sides of the aluminum sheet shall be coated with a corrosion inhibiting primer or pretreatment system and an acrylic or polyester topcoat.
   B. Topcoat finish shall be available in at least 10 different colors.

2.04  RELATED MATERIALS
   A. Elastomeric Joint Sealant.
PART 3  EXECUTION

3.01 INSTALLATION

A. Before starting work, verify governing dimensions at site. Clean and prepare adjacent surfaces prior to securing gutters and downspouts. Install after exterior coating is applied, coordinate with paint contractor.

B. Downspouts shall be securely fastened to building at the top and bottom with intermediate supports spaced a maximum of 10-feet apart.

C. Provide downspout elbows as required.

3.02 PROTECTION

A. Care must be exercised in placing aluminum in contact with dissimilar materials. Aluminum shall not be installed in contact with dissimilar metals, concrete, pressure treated/pretreated lumber, masonry, or corrosive non-metallic materials. Dissimilar materials shall be painted or otherwise protected before contact with aluminum or when drainage from them passes over aluminum.

PART 4  SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Aluminum Gutters and Downspouts, and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 07920 – JOINT SEALANTS

PART 1   GENERAL

1.01 SECTION INCLUDES
   A. Joint Sealants for interior and exterior surfaces
   B. Flexible Joint Fillers
   C. Backer Rods

1.02 RELATED SECTIONS
   A. Section 03300 – Cast-In-Place Concrete
   B. Section 07410 – Metal Roof Panels
   C. Section 07715 – Aluminum Gutters and Downspouts

1.03 REFERENCES
   B. ASTM C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.

1.04 SUBMITTALS
   A. Submit under provisions of Section 01300.
   B. Manufacturer’s Technical Data Guides and application procedures.
C. Submit samples illustrating colors selected.
D. Submit laboratory tests or data validating product compliance with performance criteria specified.
E. Submit manufacturer's statement of product compatibility with intended use, and list of recommended products for each type of joint to be sealed.

1.05 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company regularly engaged in manufacturing and marketing of products specified in this section.
B. Perform work in accordance with SWRI Guide Specifications and ASTM C 1193.
C. Installer Qualifications: Qualified to perform work specified by reason of experience or training provided by product manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING
A. Deliver products in original factory packaging bearing identification of product, manufacturer, and batch number. Provide Material Safety Data Sheets for each product.
B. Store products in a location protected from freezing, damage, construction activity, precipitation, and direct sunlight in strict accordance with manufacturer's recommendations. Do not exceed product shelf-life.
C. Condition products to approximately 60 to 70 degrees F (16 to 21 degrees C) for use in accordance with manufacturer's recommendations.
D. Handle all products with appropriate precautions and care as stated on Material Safety Data Sheet.

1.07 PROJECT CONDITIONS
A. Do not use products under conditions of precipitation or freezing weather. Use appropriate measures for protection and supplementary heating to ensure proper curing conditions in accordance with manufacturer's recommendations if application during inclement weather occurs.
B. Ensure substrate is dry and prepared according to manufacturer's written recommendations.
C. Protect adjacent work from contamination due to mixing, handling, and application of flexible epoxy joint filler.

1.08 WARRANTY
A. Provide manufacturer's material warranty, five-years minimum.
B. Include coverage for replacement of sealant materials which fail to achieve water tight seal, exhibit loss of adhesion or cohesion, or do not cure.
PART 2  PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Sonneborn
   2. GE
   3. Dow Corning
   4. Pecora
   5. Tremco
   6. WR Meadows

B. Provide all joint sealers of the same type from a single manufacturer.

C. Specification uses Sonneborn product names. Submit equal products for approval.

2.02 MATERIALS

A. Single Component, Non-Sag Polyurethane Sealant: ±25% movement capability for vertical joints; ASTM C 920, Type S, Grade NS, Class 25, Use NT, M, A, G, and O; FS TT-S-00230C, Type II, Class A; USDA approved; SWRI validated; UL classified (fire resistance). Sonneborn “Sonolastic NP 1”

B. Two Component, Non-Sag Polyurethane Sealant: ±50% movement capability for vertical joints; ASTM C 920, Type M, Grade NS, Class 25, Use NT, T, G, A, M, and O; FS TT-S-00227E, Type II, Class A; USDA approved; SWRI validated; UL classified (fire resistance). Sonneborn “Sonolastic NP 2”


D. Two Component, Self-Leveling Polyurethane Sealant: ±25% movement capability for horizontal joints; ASTM C 920, Type M, Grade P, Class 25, Use T and M; FS TT-S-00227E, Type I, Class A; USDA approved. Sonneborn “Sonolastic SL 2”

E. Siliconized Acrylic Latex Sealant: ASTM C 834; USDA compliant. Sonneborn “Sonolac”.

F. UV Resistant Silicone Sealant: ASTM C 920, Type S, Grade NS, Class 25, Use NT, A, and M; FS TT-S-001543A, Type Non-Sag, Class A; FS TT-S-00230C, Type II, Class A; USDA approved; SWRI validated. Sonneborn “OmniSeal”.

G. Mildew Resistant Silicone Sealant: ±25% joint movement capability; ASTM C 920, Type S, Grade NS, Class 25, uses NT, G, and A; FS TT-S-001543A, Type Non-Sag, Class A; USDA approved; SWRI validated. Sonneborn “OmniPlus”.

H. NSF Approved Polysulfide Sealant: ±25% joint movement capability; ASTM C 920, Type M, Grade NS, Class 25, Use T, G, M, A, and O; FS TT-S-00227E, Type II, Class A; USDA approved; ANSI/NSF Standard 61 Certified. Sonneborn “Sonolastic Polysulfide Sealant”.
I. **Poured Flexible Epoxy Joint Filler:** Sonneborn “Epolith-P”; two component 100% solids epoxy joint filler with flexible, pourable, self-leveling properties.

2. Shore D Hardness: 34.
3. Elongation: 75%.
4. Tensile Strength: 655 psi (4.5 MPa) ±10 psi (0.07 MPa).
5. Mixing Ratio: 1 to 1 by volume.
6. Pot Life: 40 to 55 minutes at 75 degrees F (24 degrees C).
7. Cure Time, Foot Traffic: 4 hours.

J. **Gunned Flexible Epoxy Joint Filler:** Sonneborn "Epolith-G"; two component 100% solids, gun-grade epoxy joint filler with flexible, pick-proof properties for sloped areas.

3. Elongation: 50%.
4. Tensile Strength: 900 psi (6.2 MPa) ±10 psi (0.07 MPa).
5. Slant Shear Strength: 865 psi (6.0 MPa) per ASTM C 882.
6. Slant Shear Strength: 112 psi (0.8 MPa) per ASTM C 321.
7. Mixing Ratio: 1 to 1 by volume.
8. Pot Life: 40 to 55 minutes at 75 degrees F (24 degrees C).

2.03 **ACCESSORIES**

A. **Primer:** Sealant manufacturer’s recommended primer when needed.

B. **Joint Cleaner:** Non-corrosive and non-staining type recommended by sealant manufacturer and compatible with joint forming materials.

C. **Soft Backer Rod:** non-gassing, reticulated closed-cell polyethylene rod designed for use with cold-applied joint sealants.

2. Size required for joint design.

D. **Closed-Cell Backer Rod:** closed-cell polyethylene rod designed for use with cold-applied joint sealants for on-grade or below-grade applications.

2. Size required for joint design.

E. **Joint Filler:** closed-cell polyethylene joint filler designed for use in cold joints, construction joints, or isolation joints wider than 1/4 inch (6 mm).

1. Size required for joint design.

F. **Bond Breaker:** Pressure-sensitive tape recommended by sealant manufacturer to suit application.

2.04 **COLOR**
A. Sealant Colors: Selected by Owner. Match site substrate colors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect all areas involved in work to establish extent of work, access, and need for protection of surrounding construction.

B. Protect all surroundings from flexible epoxy joint filler including, but not limited to, floors, equipment, line striping, walkways, and drives.

C. Verify proper joint depth and width for each type of use.

3.02 PREPARATION

A. Remove loose materials and foreign matter which impair adhesion of joint filler.

B. Clean joints and saw cuts by grinding, sandblasting, or wire brushing to expose a sound surface free of contamination and laitance.

C. Ensure structurally sound surfaces, dry, clean, free of dirt, moisture, loose particles, oil, grease, asphalt, tar, paint, wax, rust, waterproofing, curing and parting compounds, membrane materials, and other foreign matter.

D. Where the possibility of joint filler staining of adjacent areas or materials exists, mask joints prior to application.
   1. Do not remove masking tape before joints have been tooled and initial cure of joint filler has taken place.
   2. Work stained due to failure of proper masking precautions will not be accepted.

F. Verify sealant compatibility with substrate and proper adhesion.

3.03 INSTALLATION

A. Back-Up Material:
   1. Install appropriate size backer rod, larger than joint where necessary according to manufacturer's recommendations.
   2. Install polyethylene joint filler in joints wider than 1/4 inch (6 mm) to back-up material per manufacturer's recommendations.
   3. Do not install epoxy joint filler over backer rod.

B. Bond Breaker: Install bond-breaker strip in joint to be sealed on top of back-up material to prevent adhesion of sealant to back-up material; install per manufacturer's recommendations.

C. Sealant:
   1. Prepare sealants that require mixing; follow manufacturer's recommended procedures, mixing thoroughly.
   2. Mix only as much material as can be applied within manufacturer's recommended application time period.
3. Apply materials in accordance with manufacturer’s recommendations; take care to produce beads of proper width and depth, tool as recommended by manufacturer, and immediately remove surplus sealant.
4. Apply materials only within manufacturer’s specified application life period. Discard sealant after application life is expired or if prescribed application period has elapsed.

D. Epoxy Joint Filler:
1. Transfer entire contents of activator container thoroughly with entire contents of base container in separate container of appropriate size.
2. Mix only as much material as can be applied within manufacturer’s recommended application time period.
3. Mix with slow-speed drill (80-100 rpm) and slotted paddle. Ensure mixing paddle reaches bottom and scrapes side of container several times. Scrape paddle several times to ensure thorough mixing. Keep paddle blade below surface to avoid whipping air into material.
   a. Mix Epolith(R)-P for 5 to 7 minutes.
   b. Mix Epolith(R)-G for 8 to 10 minutes.
4. Pour Epolith-P from spouted can or professional bulk-loading caulking gun.
5. Apply Epolith-G by professional bulk-loading gun.
6. Maintain minimum joint application of 2/3 joint depth or 1 inch (25 mm), whichever is greater.
7. Fill joints from bottom up to exterior face by holding properly sized nozzle against joint bottom.
8. Tool joint to ensure maximum adhesion to joint sides, correct bead configuration, and a neat joint. Dry tool or dampen tool with Reducer 990. Do not use water or soapy water.
9. Apply materials only within manufacturer’s specified application life period. Discard joint filler after application life is expired or if prescribed application period has elapsed.

3.04 CLEANING
A. Remove uncured sealant and joint filler with xylene, toluene, or MEK, or other approved solvent. Remove cured sealant and joint filler by razor, scraping, or mechanically.
B. Remove all debris related to application of sealants from job site in accordance with all applicable regulations for hazardous waste disposal.

3.05 SCHEDULE OF JOINT SEALERS
A. Coordinate with manufacturer to obtain recommendations for each specific sealant application. Sealant used shall be manufacturer’s recommended “best choice” for each application location considering substrate materials, exposure, joint movement, joint orientation, traffic loading, etc. Submit list of manufacturer’s recommendations.
B. General-Purpose Interior and Exterior Applications:
   1. Sealant:
      a. Single component polyurethane
      b. Two component polyurethane
      c. Polysulfide
d. Silicone (where painting not required)

2. Applications:
   a. Joints and recesses between adjacent constructions and frames, sills, and subsills of windows, doors, and louvers.
   b. Coping joints and wash joints in precast concrete, cast stone, or natural stone.
   c. Masonry joints beneath shelf angles.
   d. Around penetrations in exterior walls.
   e. Under door thresholds and at bottom of door frames.
   f. Where necessary to prevent infiltration of water or air into or through exterior building envelope.

C. Other Exterior Applications:
   1. Sealant:
      a. Single component polyurethane
      b. Two component polyurethane
      c. UV Resistant Silicone (where exposed to sunlight)
      d. Mildew Resistant Silicone (roofing and flashing sealant hidden from sunlight)
   2. Applications:
      a. Between adjacent construction and gravel stops, copings, fascias, and miscellaneous flashings.
      b. Metal flashings inserted into reglet.
      c. Top edges of surface mounted counterflashing.
      d. Expansion and control joints in masonry where expansion joint covers are not indicated.
      e. Joints between new and existing exterior construction.

D. Interior Wetted Areas:
   1. Sealant: Mildew Resistant Silicone
   2. Applications: Between adjacent construction and vanities, shower stalls, bathtub and shower enclosures, sinks, counter tops, plumbing cut-outs, and plumbing fixtures.

A. Other Interior Applications:
   1. Sealant:
      a. Single component polyurethane
b. Two component polyurethane

c. Polysulfide

d. Acrylic Latex

2. Applications:

a. Between adjacent construction and equipment, shelving, casework, and furniture.

b. Perimeters of door and window frames, access panels.

c. Between interior partitions and adjoining concrete or steel columns, walls, or other construction.

d. Other exposed locations within partitions to seal against passage of air.

e. Other interior joints of small dimension which require painting.

f. Gypsum board partitions:

1. Between gypsum panels and dissimilar walls; install sealant just prior to installation of gypsum panel.

2. Between adjacent face layers of abutting intersection gypsum board partitions; install sealant before taping and finishing joint.

3. Between gypsum panels and penetrations: Seal around openings of ducts and pipes.

4. Seal control joints prior to installing control joint trim.

g. Other concealed locations within partitions to completely seal against passage of air.

3. Allow sealant to cure before painting over joint.

B. Exterior Traffic Surfaces:

1. Sealant:

   a. Two component self-leveling polyurethane.

   b. Single component self-leveling polyurethane.

2. Applications:

   a. Control and expansion joints in sidewalks and pavements.

C. Interior Traffic Surfaces (where joint will be covered with floor covering):

1. Sealant:

   a. Two component self-leveling polyurethane.
b. Single component self-leveling polyurethane.

2. Applications:
   a. Control and expansion joints in floors.

D. Interior Traffic Surfaces (where no floor covering will be installed):
   1. Surface preparation: Freshly saw-cut or blast-clean joints; blow with oil-free compressed air.
      a. Pour flush with adjacent surface in 2 pours in accordance with manufacturer's instructions.
   3. Applications: Control joints in floors subject to vehicular traffic.

E. Glazing:
   1. Sealant:
      a. Silicone.
   2. Applications:
      a. Glazing, including butt and lap sheer joints, stopless glazing, and cap, head and toe bead in conventional glazing.

J. Joints to be submerged:
   1. Sealant:
      a. Polysulfide Sealant
   2. Applications:
      a. Control joints at submerged locations.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

   A. Payment for Joint Sealants and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
# DIVISION 8- DOORS AND WINDOWS
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PART 1  GENERAL

1.01  SUMMARY
A. Section includes steel doors with light kits for control building. Also included is door installation.

1.02  RELATED WORK
A. Section 08710 – Door Hardware
B. Division 9 for painting

1.03  REFERENCES
A. American Society for Testing and Materials
   1. ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus
   2. ASTM E 283 – Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
   4. ASTM A 653 – Standard Specification for Steel, Sheet, Zinc-Coated (Galvannealed) by the Hot-Dip Process
   5. ASTM A 924 – Standard Specification for General Requirements for Steel, Sheet, Metallic Coated by the Hot-Dip Process
B. American National Standards Institute
   1. ANSI A224.1 – Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
   2. ANSI A250.3 – Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
   3. ANSI A250.4 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing
   4. ANSI A250.6 (SDI 107) – Hardware on Standard Steel Doors (Reinforcement-Application)
   5. ANSI A250.7 – Nomenclature for Steel Doors and Steel Door Frames
   6. ANSI A250.8 (SDI-100) – Recommended Specifications for Steel Doors & Frames
7. ANSI A250.10 – Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames

8. ANSI/DHI A115 – Specifications for Hardware Preparations in Standard Steel Doors and Frames


C. Steel Door Institute

1. SDI 106 – Recommended Standard Door Type Nomenclature

2. SDI 108 – Recommended Selection and Usage Guide for Standard Steel Doors

3. SDI 109 – Hardware for Standard Steel Doors & Frames

4. SDI 111 – Recommended Standard Details for Steel Doors and Frames

5. SDI 112 – Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors & Frames


7. SDI 124 – Maintenance of Standard Steel Doors and Frames

1.04 REGULATORY REQUIREMENTS

A. Doors and frames shall conform to applicable codes for fire ratings.

B. Install fire labeled doors and frame products in accordance with NFPA-80, current edition.

1.05 SUBMITTALS

A. Submit shop drawings, product data, and O&M data under provisions of Division 1.

B. Indicate door elevations, material thickness, internal reinforcement, closure method, and cutouts for louvers.

C. Submit manufacturer’s installation instructions and other information as necessary to show specification and code compliance.

D. Submit samples of manufacturer’s colors for Owner selection.

1.06 DELIVERY, STORAGE AND PROTECTION

A. Doors shall be stored in an upright position under cover. Place the units on at least 4-inch wood sills on floors in a manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chambers and promote rusting. If the corrugated wrapper on the door becomes wet, or moisture appears, remove the wrapper immediately.
PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Doors and Frames shall be manufactured by Amweld, Steelcraft, Fleming, or approved equal. All products supplied under this Section shall be from a single manufacturer.

2.02 MATERIALS

A. Frames, frame components, and doors shall be manufactured tension leveled steel conforming to ASTM A924, galvanized to ASTM A653, commercial steel (CS), coating designation A40 (Galvanneal). Galvannealed steel shall be treated to insure proper paint adhesion. All steel component parts used in galvannealed doors and/or frames shall meet the galvanized specification.

B. All exterior doors, frames and frame components shall be cleaned, phosphatized and finished as standard with one coat of rust inhibiting prime paint in accordance with ANSI A250.10. Exterior doors and frames will be field painted.

2.03 DOORS

A. Exterior doors

1. 16-gage hot dipped galvannealed steel, with closed tops.

2. Full-flush Seamless construction, continuous smooth welded or epoxy filled mechanically interlocked edge seams.

3. Sizes and style as shown on the drawings. Verify size and thickness with on-site measurements.

B. Construction of Doors:

1. Doors shall be reinforced, stiffened, sound deadened and insulated with impregnated specified core completely filling the inside of the doors and laminated to inside faces of both panels using contact adhesive applied to both panels and core.

2. Door shall have continuous vertical mechanical interlocking or welded joints at lock and hinge edges with visible edge seams (interior) or with edge seam filled and ground smooth (exterior). The internal portion of the seam shall be sealed with epoxy, or welded. An intermittent fastening along the seam is not permitted. Doors shall have beveled (1/8" in 2") hinge and lock edges. Top and bottom steel reinforcement channels shall be galvannealed 14 gauge and projection welded to both panels.

3. Hinge reinforcements shall be 7-gauge for 1-3/4” doors. Lock reinforcements shall be 16 gage and closer reinforcements 14 gauge - box minimum 6" high and 20" long. Hinge and lock reinforcements shall be projection welded to the edge of the door. Doors shall be factory blanked, reinforced, drilled and tapped for fully templated hardware and factory blanked and reinforced for hardware that is not fully templated. Galvannealed doors shall have galvannealed hardware reinforcements. Adequate reinforcements shall be provided for other hardware as required. Coordinate with specified hardware. Hinge locations must match existing frames, Contractor to verify.
4. Trim for doors with cutouts shall be 24-gage steel conforming to ASTM designation A 924 hot dipped galvannealed steel with a zinc coating of 0.06 ounces per square foot (A60). The trim shall be installed into the door as a four sided welded assembly. The trim shall cap the cutout but shall not extend more than 1/16" from the door face. The corners of the assembly shall be mitered, reinforced and welded. The trim shall be the same on both sides of the door. Exposed fasteners shall not be permitted. Label and non-label doors shall use the same trim.

5. All exterior out swing doors shall have the tops closed to eliminate moisture penetration. Door tops shall no have holes or openings. Top caps are permitted. All exterior doors shall include a self-adjusting, concealed door sweep installed in the bottom channel. The bottom seal shall not utilize springs.

6. Door faces shall be fabricated without visible seams, free of scale, pitting, coil brakes, buckles or waves.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify door frame openings are installed plumb, true and level, and dimensionally correct before beginning the installation process. Make corrections and/or adjustments as necessary.

B. Verify that proper door and frame reinforcement has been provided for the specified hardware and that cutouts and reinforcements are properly located.

C. Select fasteners of adequate type, number and quality to perform the intended functions.

D. Verify that louver cutouts are located and sized properly.

3.02 INSTALLATION

A. Doors and frames shall be installed in accordance with ANSI/DHI A115.IG Installation Guide for Doors and Frames and manufacturer’s installation instructions.

B. Adjust operable parts for correct clearances and function.

C. Exposed field welds shall be finished to present a smooth, uniform surface. Touch-up with rust inhibitive primer.

D. Exposed surfaces that have been scratched or otherwise marred during shipment, installation or handling shall be touched-up with a rust inhibitive primer.

E. Finish paint in accordance with Section 09900.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Steel Doors and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.
SECTION 08710 – DOOR HARDWARE

PART 1  GENERAL

1.01  SUMMARY

A. Section includes items known commercially as finish hardware or builders hardware, required for swing and other doors.

B. Types of finish hardware may include: hinges, lock cylinders and keys, lock and latchsets, bolts, thresholds, protection plates, weather-stripping, sound stripping, astragals, and other miscellaneous door hardware as required.

1.02  REFERENCES

A. ANSI A117.1 – American National Standards Institute Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People

B. ANSI A115.1 – Specification for Standard Steel Door and Frame Preparation for Mortise Locks for 1 3/8” and 1 ¾” Doors

C. ANSI A115.2 – Specification for Standard Steel Door and Frame Preparation for Bored or Cylindrical Locks for 1 3/8” and 1 ¾” Doors.

D. ANSI/BHMA A156.2 – Bored and Preassembled Locks and Latches

E. ANSI/BHMA A156.13 – Mortise Locks and Latches

F. ANSI/BHMA A156.18 – Materials and Finishes

G. National Fire Protection Association (NFPA) Standard No. 80. This requirement takes precedence over other requirements for such hardware.

1.03  SUBMITTALS

A. Submit Hardware Schedule, 3 copies

1. Detailed hardware schedule shall be prepared by an experienced hardware consultant. All items shall be suitable for the intended location and purpose.

2. Hardware finish and styles shall match as closely as possible at all locations.

3. Organize hardware schedule into “hardware sets” for each door, indicating complete designations of every item.

4. Include manufacturer’s technical data and hardware directions for each door.

5. Do not order materials until Schedule has been reviewed and approved by the Engineer.

B. Deliver templates to fabricators of other work which is to receive finish hardware.

1.04  QUALITY ASSURANCE

A. Use products of similar type from one manufacturer throughout project. Coordinate with manufacturer for proper use and installation of each piece of hardware.
B. Hardware supplier shall be a recognized builders hardware supplier, who has been furnishing hardware in Oregon for a period of not less than 3 years. Supplier shall employ an experienced AHC certified hardware consultant, available for consultation during the course of the work.

C. Hardware supplier shall prepare detailed hardware schedule based on these specifications and their experience for the best use and function of hardware.

1.05 WARRANTY

A. Blanket coverage on locksets for a minimum period of 5 years. Mechanical failure on door closers for 5 years. Failure on other parts of hardware for 2 years. These minimums may be superceded by specific requirements in the following sections.

PART 2 PRODUCTS

2.01 FINISH

A. All hardware shall have a silver satin (dull, brushed) finish. Finishes from various manufacturers and different hardware shall be matched as closely as possible.

2.02 HINGES

A. Five knuckle, button tip, full mortise template type with non-rising loose pins and ball bearings. Manufactured by Stanley; or approved equal.

B. Doors up to 36-inches wide: 4.5-inch by 4.5-inch. Provide at least 3 hinges per leaf for doors up to 86-inches high.

C. Exterior Doors: 4 ball bearing, stainless steel, 0.180 gage minimum hinges with non-removable pin construction.

2.03 LOCKS


1. Lockset must be cylindrical type with minimum 2 ¾-inch backset, with 1/2-inch throw latchbolt.
2. Lockset with 6-pin interchangeable and masterkeyed core.
3. Keyed lever to be removeable only after core is removed, by authorized control key, to allow access to lever “keeper”.
4. Locks to have solid shank with no opening for access to keyed lever keeper.
5. Locksets and latchsets must conform to ANSI A156.2, Series 4000, Grade 1. and be UL listed.
6. Keys shall be matched to Owner’s existing pump station master key set. Provide matching keys and coordinate with Owner.

2.04 THRESHOLDS

A. Thresholds shall have height and shape conforming to ANSI A117.1 with height not exceeding ½-inch. Aluminum with corrugated surface.

2.05 WEATHERSTRIPPING
A. Silicone rubber seal. Provide at each edge of every exterior door. Pemko, Reese, or approved equal.

2.06 KEYING

A. All door locks shall be keyed alike for a single building. Contractor shall provide contractor lock cores for use during construction. Replacement lock cores shall be provided in unopened packaging to the Owner upon completion.

2.07 HARDWARE SCHEDULE

A. Exterior Doors

1. Heavy-Duty Cylindrical Locks
2. Heavy-Duty Security Deadbolts
3. Threshold
4. Weatherstripping

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure that door and frame reinforcements have been provided properly for the hardware to be used.

B. Have sufficient quantities of fasteners required. Use fasteners supplied by the hardware manufacturer.

C. Doors to be field painted shall be painted prior to installing hardware.

3.02 INSTALLATION

A. Install door hardware in accordance with the manufacturer's instructions. Use fasteners provided by hardware manufacturer.

B. Ensure that proper hardware is mounted for each specific door according to the approved hardware schedule. Note where left and right handed doors are shown.

C. Adjust strikes, latches and closers for proper function. Readjust prior to final acceptance if necessary.

D. Upon completion, deliver all keys to Owner.

E. Standards: Install in accordance with requirements of DHI and BHMA. Mounting height measurements are from finish floor except top butt.

1. Butts: Top 11 3/4" center of butt to top of door; intermediate equal distance between top and bottom butts; bottom 13" to center of butt.
2. Knob Locks: 40 5/16" to center of strike.
3. Deadlocks: 48" to center of strike.
4. ADA Standard: Conform to ANSI A117.1 for positioning requirements for disabled.
PART 4  SPECIAL PROVISIONS

4.01  MEASUREMENT AND PAYMENT

A. Payment for Door Hardware and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
DIVISION 9- FINISHES  
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<td>HIGH PERFORMANCE COATINGS</td>
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SECTION 09900 – PAINTS AND COATINGS

PART 1  GENERAL

1.01 WORK INCLUDED

A. Work in this section includes furnishing and field application of all paints and coating systems required for interior and exterior coating of drywall, wood, steel, iron, plastic, concrete, masonry, and other materials to be painted.

1. Unless otherwise specified or shown, paint all surfaces and items that are exposed to view.

B. Section also necessary surface preparation, protection, curing and touch-up.

C. Summary of items to be painted on this project under this section include:

1. Exposed piping, including pipe inside vaults.

2. Interior ceiling and CMU walls.

3. Steel doors and frames on control building.

4. Exterior wood trim and other exposed wood.

5. Any new materials provided not prefinished or painted.

1.02 RELATED SECTIONS

A. Division 15 – Mechanical: Fabricated and/or shop primed items

B. Division 16 – Electrical: Fabricated and/or shop primed items

1.03 SURFACES NOT TO BE PAINTED

A. Prefinished items including finished metal surfaces.

B. Walls or ceilings of concealed or inaccessible areas.

C. Fire or smoke rating labels on doors or frames.

D. Equipment name plates.

E. Piping identification labels.

F. Moving parts of mechanical or electrical equipment.

G. Cast in place concrete surfaces.

1.04 SUBMITTALS

A. Product Data

1. Materials List: Complete list of proposed manufacturers and products.

2. Manufacturer's Specifications: Manufacturer’s technical information for each product, including paint analysis and application instructions.
3. Material safety data sheets for each product.

B. Samples: Preliminary Samples: 8-1/2" x 11" samples of each color, texture and sheen on glossy card stock. Owner will select colors to be used from manufacturer's standard.

D. Certificates: Provide certificate from each manufacturer stating material is premium quality and suitable for intended use on this Project.

E. Closeout Submittals:
   1. Two copies of manufacturer's color and sheen formula, and 4" x 6" color chips, for each final color used in the Project.
   2. Product Usage Records: Three copies of product usage records for each paint, coating and solvent product used in the project. Include product name, amount used, surface preparation records, and period of time over which the product was used.

1.05 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the work of this section with minimum 5 years successful experience in work of similar scope.

B. Regulatory Requirements: Products containing chromates, cadmium, lead, or mercury or are not permitted.

C. Manufacturer's Instructions: Perform painting work in accordance with manufacturer's written instructions and recommendations.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the Project in original, new, unbroken packages and containers bearing manufacturer's name and label, with:
   1. Name of material, color and sheen.
   2. Manufacturer's name, product number and date of manufacture.
   3. Contents by volume of major pigments and vehicle constituents.
   4. Thinning and application instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers: ICI Paint Stores, Tnemec, Benjamin Moore, or Sherwin Williams.

1. Unless otherwise indicated, Tnemec products are specified in Paint Schedule Articles 3.03 to establish standards and type of materials required. Equal products of manufacturers specified above are acceptable.

2.02 MATERIALS
A. Material Quality

1. Provide premium quality materials. Materials not bearing manufacturer’s identification as a premium-grade product are not acceptable.

2. Should manufacturer’s specifications or product numbers change, provide its current equal or better product.

3. Primer and undercoats are to be of same manufacturer as final coat.

4. Materials left from previous jobs are not acceptable.

5. Use only thinners approved by paint manufacturer, and use only within recommended limits.

6. Etching Solutions: As recommended by paint manufacturer for the use intended.

7. Solvents: Non-petroleum based, as recommended by paint manufacturer for the use intended.

B. Finish Coat Coordination: Provide finish coats which are compatible with prime paints used.

2.03 COLORS

A. General

1. Use of proprietary names in color selections does not imply exclusion of equivalent products of other manufacturers.

2. The proposal and acceptance of any paint manufacturer shall not restrict the owner to selection of standard colors of that manufacturer.

B. Finish coat colors shall be factory mixed.

PART 3 EXECUTION

3.01 PREPARATION

A. Perform preparation and cleaning procedures in accordance with paint manufacturer’s instructions and as specified for substrate condition.

B. Remove hardware, accessories, and items in place and not to be painted, or provide protection prior to surface preparation and painting. Reinstall removed items after painting.

C. Clean surfaces before applying paint. Remove oil and grease prior to mechanical cleaning. Schedule cleaning so contaminants from cleaning process do not fall onto wet, newly painted surfaces.

D. Moisture Content: Do not paint over surfaces where moisture content exceeds manufacturer’s instructions.

E. Ferrous Metals:
1. **Bare Surfaces**: Clean of oil, dirt, loose mill scale, and other foreign substances with solvent or by mechanical cleaning.

2. **Shop Applied Primer**: Touch up where damaged or bare using same type of primer as adjacent surfaces.

3. **Galvanized Surfaces**: Clean free of oil and surface contaminants using solvent.

F. **Plywood/Gypsum Board**: Remove dust, and repair surface imperfections. Spot-prime defects after repair.

G. **Mix painting materials in accordance with manufacturer’s instructions**.

H. **Store materials in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.**

I. **Stir materials before application to produce mixture of uniform density, and stir as required during application. Do not stir surface film into material, strain material before using if necessary.**

### 3.02 APPLICATION

A. **Apply paint in accordance with manufacturer’s instructions. Use applicators and techniques best suited for substrate and type of material being applied.**

1. **Apply additional coats when stains or blemishes show through final coat, until paint is a uniform finish, color and appearance.**

2. **Ensure dry film thickness at corners and crevices is equivalent to that of flat surfaces.**

3. **Sand lightly between each succeeding enamel or varnish coat.**

4. **Finish exterior doors on tops, bottoms and side edges same as exterior faces.**

B. **Scheduling Painting**: Apply first coat to surfaces that have been cleaned, pretreated or otherwise prepared for paint as soon as practicable after preparation.

1. **Do not apply materials in areas where dust is being generated, or will be generated, before coatings are thoroughly dry.**

2. **Allow time between successive coats to permit proper drying.**

3. **Do not recoat until paint feels firm and does not deform or feel sticky under moderate thumb pressure.**

C. **Minimum Coating Thickness**: Apply materials at not less than manufacturer’s recommended spreading rate, to achieve a total dry film thickness (DFT) as recommended by coating manufacturer and as specified.

D. **Prime Coats**: Apply to items not previously primed. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat.
### E. Finish Coats: Provide even texture. Leave no laps, irregularity in texture, skid marks, or other surface imperfections.

1. **Opaque Finishes:** Provide opaque, uniform finish, color and coverage. Cloudiness, spotting, holidays, brush marks, runs, sags, ropiness or other surface imperfections are not acceptable.

2. **Transparent Finishes:** Provide glass smooth surface film of even luster. Cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections are not acceptable.

### F. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not accepted.

### 3.03 PAINT SCHEDULE

#### EXTERIOR COATINGS

<table>
<thead>
<tr>
<th>Location</th>
<th>Preparation</th>
<th>Primer / Intermediate</th>
<th>Finish Coats</th>
<th>Total DFT</th>
</tr>
</thead>
</table>
| Unprimed Metals      | Commercial Blast (SSPC-SP6)      | Series 66 or N69 Hi-Build Epoxoline Two coats
DFT 3.0-5.0 mils, each coat | Series 73, or 1075 Endura-Shield Polyurethane
DFT 2.0-5.0 mils       | 9.0 – 13.0 mils                 |
| Shop-Primed Metals   | Hand Tool or Power Tool (SSPC-SP2 or SP3) | Factory Primed Intermediate coat of Series 27 Typoxy
DFT 2.0-3.0 mils        | Series 73, or 1075 Endura-Shield Polyurethane
DFT 2.0-3.0 mils       | 4.0 – 6.0 mils                  |
| Wood                 | Clean and Dry                    | Series 36 Undercoater
DFT 2.0-3.5 mils        | Series 23 Enduratone
DFT 2.0-3.0 mils        | 4.0 – 6.5 mils                  |
| Ductile Iron Pipe    | As recommended by manufacturer   | Series 66 or 69 DFT
3.0 to 3.0 mils/
Intermediate coat Series 66 or 69 DFT
4.0 to 6.0 mils        | Series 73, 1074 or 1075 DFT 2.0 to 3.0 mils | 9.0 – 14 mils |

#### INTERIOR COATINGS

<table>
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<tr>
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<th>Primer / Intermediate</th>
<th>Finish Coats</th>
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DFT 2.0-3.0 mils        | Series 73, or 1075 Endura-Shield Polyurethane
DFT 2.0-3.0 mils       | 4.0 – 6.0 mils                  |
| Wood                 | Clean and Dry                    | Series 36 Undercoater
DFT 2.0-3.5 mils        | Series 23 Enduratone
DFT 2.0-3.0 mils        | 4.0 – 6.5 mils                  |
3.04 APPROVED EQUALS

A. The painting materials listed above are provided as references. Approved equal materials will be allowed upon submittal.

3.05 COLOR SCHEDULE

A. Contractor to coordinate with Owner and Engineer for color selections.

B. For exterior touch-up, match existing paint colors.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Paints and Coatings and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 09960 – HIGH PERFORMANCE COATINGS

PART 1   GENERAL

1.01   WORK INCLUDED

A. Section specifies field painting. All exposed metal piping and appurtenances, including equipment (pumps, etc.) shall be painted in accordance with these specifications.

B. Section specifies prime coats that may be applied in shop under other sections.

C. Painting includes surface preparation and coating of exposed interior and exterior piping, equipment, building surfaces, doors, trim, floors, and other surfaces.

D. Paint systems for all items exposed to product water shall be ANSI/NSF Standard 61 certified for potable water contact. Make necessary equivalent substitutions per manufacturer.

1.02   RELATED WORK

A. Shop prime painting of steel and ferrous metals: Divisions 11, 13, and 16 sections.

B. Painting of wood, gypsum board, CMU, and non pipe related items: Section 09900

1.03   SUBMITTALS

A. Submit in accordance with Section 01300.

B. Manufacturer’s Literature and Data:

1. Before work is started, or sample panels are prepared, submit manufacturer’s literature, indicating brand names, product type color, gloss level, coating composition, Federal Specification Number or manufacturers name or product number where applicable, and certificates as specified.

1.04   DELIVERY AND STORAGE

A. Deliver materials to site in manufacturer’s sealed container marked to show following:

1. Name of manufacturer

2. Product type

3. Batch number

4. Instructions for use

5. Safety precautions

B. In addition to manufacturer’s label, provide a label legibly printed as following:

1. Federal Specification Number, where applicable, and name of material.

2. Surface upon which material is to be applied.

3. If paint or other coating, state coat types; prime, body or finish.
C. Maintain space for storage, and handling of painting materials and equipment in a neat and orderly condition to prevent spontaneous combustion from occurring or igniting adjacent items.

D. Store materials at site at least 24 hours before using, at a temperature between 65 and 85 °F.

**PART 2 PRODUCTS**

2.01 MATERIALS

A. Primer
   1. Tnemec Series 66 or 69 Hi-Build Epoxoline.
   2. Series 20 or 140 Pota-Pox for items exposed to product water.

B. Intermediate Coat
   1. When required, shall be same material as primer.
   2. When manufacturer’s factory primer is not Tnemec Series 66 or 69, use Tnemec Series 27 F.C. Typoxy.
   3. Series 20 or 140 Pota-Pox for items exposed to product water.

C. Finish Coat
   1. Interior Exposed
      a. Tnemec Series 66 or 69 Hi-Build Epoxoline.
   2. Immersion in Product Water
      a. Series 20 or 140 Pota-Pox for items exposed to product water.
   2. Exterior Exposed
      a. Tnemec Series 73, 1074 or 1075 Endura-Shield.

2.02 REGULATORY REQUIREMENTS

A. Paint materials shall conform to the restrictions of the local Environmental and Toxic Control jurisdiction.
   1. Volatile Organic Compounds (VOC): VOC content of paint materials shall not exceed local, state or district requirements.
   2. Lead-Base Paint: Shall not be used.
   3. Asbestos: Materials shall not contain asbestos.

**PART 3 EXECUTION**

3.01 JOB CONDITIONS
   1. Take necessary precautions to protect personnel and property from hazards due to falls, injuries, toxic fumes, fire, explosion, or other harm.
   2. Deposit soiled cleaning rags and waste materials in metal containers approved for that purpose. Dispose of such items off the site at end of each day's work.

B. Atmospheric and Surface Conditions:
   1. Do no exterior or interior painting in foggy, damp or rainy weather. The relative humidity must be below 85% and the substrate temperature at least 5 °F above the dew point.
   2. Paint exterior and interior surfaces when ambient temperature is between 50 and 90 degrees F, except when otherwise designated in manufacturer's printed instructions. Maintain interior temperatures until paint dries hard.
   3. Apply coatings only when substrate temperatures are within the range recommended in writing by the coating manufacturer.
   4. Do no exterior painting when it is windy and dusty.
   5. Do no painting in direct sunlight or on surfaces that will soon be warmed by the sun.
   6. Apply only on clean, dry and frost free surfaces.

3.02 SURFACE PREPARATION

A. Method of surface preparation is optional, provided results of finish painting produce solid even color and texture specified with no overlays.

B. General:
   1. Remove prefinished items not to be painted such as lighting fixtures, escutcheon plates, hardware, trim, and similar items for reinstallation after paint is dried.
   2. Remove items for reinstallation and complete painting of such items and adjacent areas when item or adjacent surface is not accessible or finish is different.
   3. See Section 3.05 of this specification for specific surface preparation requirements.
   4. Clean surfaces for painting with materials and methods compatible with substrate and specified finish. Remove any residue remaining from cleaning agents used.
C. Steel:
   1. Remove oil, grease, soil, drawing and cutting compounds, flux and other
detrimental foreign matter by use of solvents, emulsions, cleaning compounds, or
by steam cleaning.
   2. Remove loose mill scale, rust, and paint, by hand or power tool cleaning.
Remove weld splatter with power tools.
   3. Fill dents, holes and similar voids and depressions in flat exposed surfaces of
hollow steel doors and frames, access panels, roll-up steel doors and similar
items specified to have semi-gloss or gloss finish with metal filler compound.
Finish flush with adjacent surfaces.
      a. This includes flat head countersunk screws used for permanent anchors
      b. Do not fill screws of item intended for removal such as glazing beads.
   4. Spot prime abraded and damaged areas in shop prime coat that expose bare
metal with same type of paint used for prime coat. Feather edge of spot prime to
produce smooth finish coat.
   5. Spot prime abraded and damaged areas that expose bare metal of factory
finished items with paint as recommended by manufacturer of item.
   6. Surface preparation shall be as shown in the table in Section 3.5.

D. Zinc-Coated (Galvanized) Metal Surfaces:
   1. Clean surfaces to remove grease, oil and other deterrents to paint adhesion, with
toluene, xylene or similar solvents in accordance with SSPC-SP 1. Scarify by
whatever means feasible to achieve a minimum 1.5 mil anchor pattern.
   2. Spot coat abraded and damaged areas of zinc coating which expose base metal,
using zinc rich paint MIL Spec MIL-P-21035, on hot-dip zinc-coated items and
spot prime with zinc dust primer, Fed Spec. TT-P-641.
   3. Follow paint system manufacturer’s recommendations.

E. Ductile and Cast iron:
   1. Follow paint system manufacturer’s recommendations.

F. Concrete:
   1. Shot blast or mechanically abrade per ASTM D4259. Comply with SSPC-SP13.

3.03 PAINT PREPARATION
   A. Thoroughly mix painting materials to ensure uniformity of color, complete dispersion of
pigment and uniform composition.
   B. Do not thin unless necessary for application and when finish paint is used for body and
prime coats. Use materials and quantities for thinning as specified in manufacturer’s
printed instructions.
C. Remove paint skins, then strain paint through commercial paint strainer to remove lumps and other particles.

D. Mix two component and two-part paint and those requiring additives in such a manner as to uniformly blend as specified in manufacturer's printed instructions unless specified otherwise. Do not break down prepackaged kits.

E. For tinting required to produce exact shades specified, use color pigment recommended by the paint manufacturer.

3.04 APPLICATION

A. Start of surface preparation or painting will be construed as acceptance of the surface as satisfactory for the application of materials.

B. Unless otherwise specified, apply paint in three coats; prime, body, and finish. When two coats applied to prime coat are the same, first coat applied over primer is body coat and second coat is finish coat.

C. Apply each coat evenly and cover substrate completely.

D. Allow not less than 48 hours between applications of succeeding coats, except as allowed by manufacturer's printed instructions, and approved by Resident Engineer.

E. Finish surfaces to show solid even color, free from runs, lumps, brushmarks, laps, holidays, or other defects.

F. Apply by brush, roller or spray, except as otherwise specified.

G. Do not spray paint in existing occupied spaces unless approved by Resident Engineer, except in spaces sealed from existing occupied spaces.

H. Do not paint in closed position operable items such as access doors and panels, window sashes, overhead doors, and similar items except overhead roll-up doors and shutters.

3.05 PAINT SYSTEMS

A. Primer shall be epoxy applied to a Dry Film Thickness as shown. More than one coat may be required.

B. Intermediate (body) coat required on exterior exposed surfaces of ductile or cast iron. DFT of 4.0 to 6.0 Mils. All factory-primed steel not using specified primer shall have an intermediate coating of the specified material (Series 27 F.C. Typoxy) with a DFT of 2.0 to 3.0 Mils.

C. Finish coating shall be epoxy on interior and immersion surfaces and shall be polyurethane for exterior surfaces. More than one application may be required to achieve specified DFT.

D. The following table details painting system requirements and is based on the specified Tnemec products

E. All surfaces to be coated that will be in contact with product water shall be coated with an NSF listed coating system as specified.
### Exposure | Surface Prep. | Primer | Intermediate DFT | Finish | Total DFT
--- | --- | --- | --- | --- | ---
**STEEL**
Exterior Exposed | SSPC-SP6 | 3.0 to 5.0 Mils Series 66 or 69 | ~ | 3.0 to 5.0 Mils Series 73, 1074, 1075 | 6.0 to 10.0 Mils
Interior Exposed | SSPC-SP6 | 3.0 to 5.0 Mils Series 66 or 69 | ~ | 4.0 to 6.0 Mils Series 66 or 69 | 7.0 to 11.0 Mils
Immersion | SSPC-SP10 | 3.0 to 5.0 Mils Series 20 or 140 | ~ | 4.0 to 6.0 Mils Series 20 or 140 | 7.0 to 11.0 Mils
**FACTORY PRIMED STEEL**
Exterior Exposed | Clean and Dry | Factory | 2.0 to 3.0 Mils Series 27 F.C. | 3.0 to 4.0 Mils Series 73, 1074, 1075 | 5.0 to 7.0 Mils
Interior Exposed | Clean and Dry | Factory | 2.0 to 3.0 Mils Series 27 F.C. | 4.0 to 6.0 Mils Series 66 or 69 | 6.0 to 9.0 Mils
**GALVANIZED METAL AND NON-FERROUS METAL**
Exterior Exposed | as recommended | 2.0 to 3.0 Mils Series 66 or 69 | ~ | 2.0 to 3.0 Mils Series 73, 1074, 1075 | 4.0 to 6.0 Mils
Interior Exposed | as recommended | 2.0 to 3.0 Mils Series 66 or 69 | ~ | 2.0 to 3.0 Mils Series 66 or 69 | 4.0 to 6.0 Mils
Immersion | SSPC-SP1 w/ brush off blast | 3.0 to 5.0 Mils Series 20 or 140 | ~ | 4.0 to 6.0 Mils Series 20 or 140 | 7.0 to 11.0 Mils
**DUCTILE OR CAST IRON**
Exterior Exposed | as recommended | 3.0 to 5.0 Mils Series 66 or 69 | 4.0 to 6.0 Mils Series 66 or 69 | 2.0 to 3.0 Mils Series 73, 1074, 1075 | 9.0 to 14.0 Mils
Interior Exposed | as recommended | 3.0 to 5.0 Mils Series 66 or 69 | ~ | 4.0 to 6.0 Mils Series 66 or 69 | 7.0 to 11.0 Mils
Immersion | as recommended | 3.0 to 5.0 Mils Series 20 or 140 | ~ | 4.0 to 6.0 Mils Series 20 or 140 | 7.0 to 11.0 Mils
**PVC**
Exterior Exposed | Scarify | 2.0 to 3.0 Mils Series 66 or 69 | ~ | 2.0 to 3.0 Mils Series 73, 1074, 1075 | 4.0 to 6.0 Mils
Interior Exposed | Scarify | 2.0 to 3.0 Mils Series 66 or 69 | ~ | 2.0 to 3.0 Mils Series 66 or 69 | 4.0 to 6.0 Mils

### 3.06 REFINISHING EXISTING PAINTED SURFACES

A. Clean, patch and repair existing surfaces as specified under surface preparation.
B. Remove and reinstall items as specified under surface preparation.

C. Remove existing finishes or apply separation coats to prevent non-compatible coatings from having contact. Test patches should be performed per ASTM D5064.

D. Patched or Replaced Areas in Surfaces and Components: Apply spot prime and body coats as specified for new work to repaired areas or replaced components.

E. Except where scheduled for complete painting apply finish coat over plane surface to nearest break in plane, such as corner, reveal, or frame.

F. Refinish areas as specified for new work to match adjoining work unless specified or scheduled otherwise.

G. Sand or dull glossy surfaces prior to painting.

H. Sand existing coatings to a feather edge so that transition between new and existing finish will not show in finished work.

3.07 PAINT COLOR

A. Color of priming coat: Lighter than body coat. Color of body coat: Lighter than finish coat. Color prime and body coats to not show through the finish coat and to mask surface imperfections or contrasts.

B. Colors: *(per Recommended Standards for Water Works)*

<table>
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<tr>
<th>Item</th>
<th>Generic Color</th>
<th>Color, Tnemec</th>
</tr>
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<tr>
<td>Raw Water Piping</td>
<td>Olive Green</td>
<td>EN07, Clover</td>
</tr>
<tr>
<td>Finished Water Piping</td>
<td>Dark Blue</td>
<td>SC06, Safety Blue</td>
</tr>
<tr>
<td>Drain and Waste Piping</td>
<td>Light Brown</td>
<td>YB31, Twine</td>
</tr>
<tr>
<td>Air Scour Piping</td>
<td>Dark Green</td>
<td>EN09, Balsam</td>
</tr>
<tr>
<td>Pumps and Motors</td>
<td>Dark Blue</td>
<td>SC06, Safety Blue</td>
</tr>
<tr>
<td>Pipe Supports, Hangers</td>
<td>Light Grey</td>
<td>IN01, ANSI No. 70</td>
</tr>
</tbody>
</table>

C. Submit colors samples for Owner approval. Owner may elect to have different colors provided.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. All materials and work in this Section shall be paid for as a portion of the lump sum price as stated on the Bid Form for the Ductile iron Site Piping, Valves and Fittings. No separate payment for this item will be made.

END OF SECTION
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SECTION 11310 – SUBMERSIBLE CENTRIFUGAL PUMPS

PART 1  GENERAL

1.01  SECTION INCLUDES

A. Specifications for the submersible centrifugal pumps and motors for wastewater pumping.

1.02  SUMMARY

A. Two (2) pumps are required, 1 duty pump and 1 pump for redundancy. Each pump will run independently, or in conjunction with one other pump to meet the duty point. Maximum design flow will be achieved with one (1) pump running. Pumps will alternate starts and run cycles to achieve approximately equal run time averages.

B. Pump shall be supplied with electric motor, close coupled volute, and cast iron discharge elbow, guide bar brackets, power cable, safe-hatch, and accessories.

C. The pump, mechanical seals and motor units provided under this specification shall be from the same manufacturer. Provide individual conduits for each pump supplied to wet well disconnect panel.

D. The safety hatch shall be supplied by the pump manufacturer to ensure proper installation of the pumps.

1.03  RELATED SECTIONS

A. Section 16415 Automatic Transfer Switch
B. Section 16230 Standby Generator
C. Section 17100 Remote Telemetry Unit Enclosed Controllers

1.04  QUALITY ASSURANCE

A. The pumps shall be heavy duty, electric submersible, centrifugal non-clog units designed for handling raw unscreened sewage and wastewater and shall be fully guaranteed for this use.

B. The pumps shall be capable of operating in an ambient liquid temperature of 104 degrees F as specified by the National Electrical Manufacturers Association (NEMA) and Factory Mutual (FM).

C. The pump and motor shall be suitable for continuous operation at full nameplate load while the motor is completely submerged or partially submerged.

D. Motor horsepower shall be sufficient to be non-overloading over entire pump curve.

E. The pump, mechanical seals and motor units provided under this specification shall be from the same manufacturer in order to achieve standardization of operation, maintenance, spare parts, manufacturer’s service and warranty.

F. The pump, motor and associated devices shall be suitable for no less than 15 evenly spaced starts per hour without overheating.

1.05  WARRANTY
A. Warranty shall meet the standard warranty requirement as outlined by the pump manufacturer and in the contract documents.

B. Warranty period shall commence on date of valid start-up.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer or as otherwise shipped and protected by the manufacturer.

B. Store equipment in a clean dry area indoors in accordance with manufacturer’s instructions. Keep containers sealed until ready to use.

C. Protect equipment during handling and installation to prevent damage or contamination.

1.07 SUBMITTALS

A. Technical submittal data shall consist of:
   1. Certified pump performance curves
   2. Anticipated frequency in Hz for flow conditions indicated in Section 2.01.A
   3. Pump outline drawing
   4. Electrical motor data
   5. Control drawing and data
   6. Typical installation guides
   7. Technical manuals
   8. Parts list
   9. Printed warranty
   10. Manufacturer’s equipment storage recommendations
   11. Manufacturer’s standard recommended start-up report form

1.08 SPARE PARTS

A. For each pump, an appropriate set of spare parts shall be provided, based on the manufacturer’s recommendations, to allow servicing of the pump and returning it to full service. At a minimum, a complete set of mechanical seals, gaskets, wear rings, and spare impeller shall be provided.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Static head approximately 40 feet.
B. System shall be capable of producing a minimum of 860 gpm at 73.4 feet total dynamic head with one pump running under old pipe conditions with $C = 120$.

C. Pumps shall be capable of running at 60 Hz, or less, for sustained periods of time without overheating.

D. Voltage requirements: 460 Volt, 3-phase, 60 Hz.

2.02 MANUFACTURER AND MODEL

A. ITT Flygt, Model NP3171 HT with 256 mm impeller. Motor shall be explosion proof, 25 hp, 460 volt, 60 Hz, 3 phase, 4 pole as supplied by ITT Flygt or approved equal.

2.03 CONSTRUCTION

A. PUMP DESIGN

1. The pumps shall be automatically and firmly connected to the discharge connection, guided by no less than two (2) guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wetwell. No portion of the pump shall bear directly on the sump floor.

B. EXPLOSION PROOF MOTOR AND CABLE

1. The pump system including the pump, motor and power cable shall be approved for use in areas classified as hazardous locations in accordance with the NEC Class I, Div. 1, Group C and D service as determined and approved by a U.S. nationally recognized testing laboratory (U.L., FM, CSA) at the time of the bidding of the project. As required by Factory Mutual (FM) the motor shall be capable of continuous operation in pumped media up to 104°F.

2. 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 cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of at least 65 feet.

3. Motors shall be Inverter Duty, premium efficiency.

4. Motor shall be NEMA design with minimum 1.15 service factor, 40°C ambient.

5. Motor shall have a voltage tolerance of ±10% from nominal, and voltage imbalance tolerance of 1%.

6. Each pump motor stator shall incorporate three thermal switches, one per stator phase 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.

7. Power cables shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. Cables shall be appropriate for use with variable frequency drives. Cables shall be routed from pump to wetwell panel in separate conduits.

C. SEALS AND BEARINGS

1. The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The minimum $L_{10}$ bearing life shall be 50,000 hours at any usable portion of the pump curve.
2. Each pump shall be provided with a lubricant chamber for the shaft seal system. Seals shall not be lubricated by the pumped medium. Seal springs shall be isolated from pumped medium.

3. Each pump shall be equipped with tandem mechanical shaft seal system. Seal rings shall be tungsten-carbide or silicon-carbide.

4. Seals shall be mechanically protected from abrasive particulate matter and fibrous material.

5. A separate seal leakage chamber shall be provided so that any leakage that may occur past the seals will be captured prior to entry into the motor stator housing. Leakage chamber shall be equipped with a device to send a signal to an alarm if the chamber should reach 50% capacity.

D. SHAFT

1. The pump shaft and motor shaft shall be an integral, on piece unit adequately designed to meet the maximum torque required at any normal start-up condition and any operational point on the pump curve. Multi-piece, welded, sleeved or mechanically coupled shafts are not acceptable.

2. Shaft shall have full shutoff head design factor of safety of 1.7 or greater.

3. Shaft shall be stainless steel. Carbon steel or chrome plated steel are not acceptable.

E. IMPELLER

4. The impeller shall be dynamically balanced to prevent vibration and shall be capable of passing a minimum 2.5-inch diameter sphere, as required by Oregon DEQ.

5. The impeller shall be constructed of grey cast iron, leading edges of impeller shall be hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in raw wastewater.

6. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw or by an adjustable wear plate.

7. The impeller shall be locked to the shaft, held by an impeller bolt and treated with a corrosion inhibitor.

F. VOLUTE

1. Pump volute shall be single-piece gray cast iron, Class 35B, non-concentric design with smooth passages large enough to pass any solids that may enter the impeller.

2. Discharge shall be 4-inch flange and shall be supplied by the pump manufacturer.

G. CABLE ENTRY

1. The cable entry design shall not require a specific torque to insure a water tight seal.

2. The cable entry shall consist of cylindrical elastomer grommets, flanked by stainless steel washers.

3. Cable entry designs which utilize potting compounds to provide a water tight seal, or those which do not allow the cable to be easily changed in the field shall not be considered equal.

H. CONTROLS – See Division 16
I. FINISH
   1. Pump and motor surfaces not constructed of stainless steel shall be factory primed and painted.

J. PROTECTION
   1. Pumps shall be equipped with moisture-sensing probes to detect moisture intrusion, and shall also have over-temperature sensors.

K. LIFTING PROVISIONS
   1. Each pump shall be fitted with minimum 3/8” Grade 30 galvanized lifting chain, or 3/8” 316 stainless steel of appropriate length, including shackles and appropriate Grip-Eyes for lifting pumps in multiple bites. Grip-Eye lifting system shall consist of stainless steel cable connected to lifting chain attached to the lifting bail of the pump. Grip-Eye shall be forged steel and designed for the intended lifting application.

L. GUIDE RAIL SYSTEM
   1. Guide rails shall be 2-inch, schedule 40 stainless steel pipe per pump manufacturer recommendations.
   2. Intermediate guide bar brackets shall be supplied. Bracket, U-Bolt and hardware shall be either stainless steel or hot-dip galvanized structural steel. Install one intermediate guide bar bracket at the center of each guide bar length (one per pump).

PART 3 EXECUTION

3.01 INSTALLATION
   A. Install in accordance with manufacturer’s instructions at locations shown on the drawings and as directed.
   B. Construct pump base in accordance with drawings and manufacturer recommendations. Level and grout as required. Use properly sized stainless steel anchor bolts. Ensure that pump is completely level and plumb.
   C. The pump and motor shall be factory assembled and tested prior to shipment to the project site. The manufacturer shall certify, and shall submit to the Engineer in writing, that all factory testing has been completed prior to shipment.

3.02 STARTUP & TESTING
   A. Manufacturer shall furnish the services of a qualified factory trained field service engineer for one 8-hour working day at the site to inspect the installation and instruct the owner’s personnel on the operation and maintenance of the pumping units. After the pumps have been completely installed and wired, the contractor shall have the manufacturer do the following:

   1. Megger stator and power cables
   2. Check seal lubrication
   3. Check for proper rotation
   4. Check power supply voltage
   5. Measure motor operating load and no load current
6. Check level control operation and sequence

B. All units shall be field tested to determine the head, flow and electrical characteristics to ensure that equipment meets the specifications. After installation, the pump shall be dry tested to ensure smooth operation of all components. Acceptance tests shall be run to ensure that each pump meets the following requirements:

1. The pumping units operate as specified without excessive noise, cavitation, vibration, or without overheating.

2. All automatic and manual controls are functional and capable of operating the pumps as specified.

3. All drive equipment operates without overload.

4. Pumps which do not provide the required flow at the stated head, or provide the required turndown flow rates, will be removed and replaced, or modified as required and accepted by the Owner.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Submersible Centrifugal Pumps and other work in this section shall be as the unit price for the Pumps as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
# DIVISION 13- SPECIAL CONSTRUCTION
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SECTION 13420 – MAGNETIC FLOW METER

PART 1   GENERAL

1.01 SECTION INCLUDES

A. Specifications for the flow meter that will measure wastewater flows discharged from the pump station.

1.02 SUMMARY

A. The meter shall be magnetic type (magmeter) complete with flanged metering tube, remote wall-mount data display/keypad/transmitter, and sufficient interconnecting signal cable.

B. Meters shall be equipped to forward analog signals to the pump controller from the meter remote display/signal converter. The flow proportional signal will be used to display rate/total (both at the remote display and the SCADA computer) and control the speed of variable frequency drive pumps to provide a specific flow as set by the Operating Strategy.

C. Flow range will range from 0 to 860 gpm for 10” ductile iron pipe.

D. Provide a spool sized to replace the flow meter in-line to allow flowmeter to be removed for service if necessary.

1.03 RELATED SECTIONS

A. Division 3 for precast concrete flowmeter vault.

B. Division 16 for signal and power wiring.

1.04 QUALITY ASSURANCE

A. Manufacturer shall specialize in flow measurement and shall have been providing flow meters for a minimum of 5 years. Entire unit, including meter body, flow transmitter, and remote display/flow computer shall be shipped as a single package from the manufacturer.

1.05 WARRANTY

A. Warranty shall meet the standard warranty requirement as outlined in the contract documents.

B. All components making up the meter shall be warranted for 24 months from date of shipment and defects due to faulty materials or workmanship will be repaired or replaced free of charge during the two-year warranty period.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer or as otherwise shipped and protected by the manufacturer.

B. Store equipment in a clean dry area indoors in accordance with manufacturer’s instructions. Keep containers sealed until ready to use.
C. Protect equipment during handling and installation to prevent damage or contamination.

**PART 2 PRODUCTS**

2.01 MANUFACTURERS & MODELS.

A. The meter shall be Endress and Hauser Proline Promag or approved equal. Meter body shall have 10-inch flanges.

2.02 CONSTRUCTION

A. Body

1. The meter tube shall be fabricated stainless steel pipe with 150 pound AWWA Class “D” flanges for mating to 10-inch pipe. Meter tubes shall have a constant nominal inside diameter offering no obstruction to the flow.

2. Interior of body shall be fully lined with polyurethane or fusion bonded epoxy.

3. Electrodes shall be 316 stainless steel, or C22 tantalum.

4. Meter body exterior shall be a factory applied corrosion resistant coating, polyurethane or Al/Zn coating.

B. Signal Converter

1. The signal converter shall be independent from the meter body and shall be supplied with up to 300 feet of interconnecting cable. Signal converter shall be wall mounted in control building. Contractor to verify installation location and order specific cable length to avoid unnecessary looping of extra cable.

2. The signal converter shall be microprocessor based with backlit LCD for continuous display of rate of flow and total volume of flow. Rate shall be displayed in gallons per minute (gpm) and totalized volume in gallons.

3. Unit shall be housed in a NEMA 4X case. Unit shall be wall-mounted in the control building as shown in the drawings or as directed by Engineer.

4. Instrument shall be factory programmed and shall include a self diagnostic test mode, password protected configuration parameters, and a front panel keypad used change display and parameters. The converter shall be compatible with Microsoft Windows and other software programs with built in terminal communication capabilities through an interface port.

5. The converter shall provide an isolated 4-20 mA output.

6. Unit shall store all data in a non-volatile memory with 10-year retention.

C. Grounding ring shall be 316 stainless steel or C-22 tantalum and shall be supplied with meter tube.

2.03 PERFORMANCE

A. When installed in accordance with manufacturer’s instructions, meter shall have the following minimum accuracy:
1. Display, serial communications and frequency output accuracy to be ±0.2% of reading or ±0.003 ft/sec, whichever is greater.

2. Repeatability and reproducibility shall be ±0.05% or ±0.0008 ft/s, whichever is greater.

2.04 FLOW METER SPACER

A. Flow meter spacer shall be constructed of 10-inch stainless steel pipe with welded flanges. Spool shall be precisely sized to replace the flow meter in-line. Contractor will be required to demonstrate spool fitment.

B. Spool shall be labeled “Flow Meter Spacing Tool”. Label shall be affixed by adhesive or industrial grade double-sided tape.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s instructions at location shown on the drawings and as directed.

B. Maintain upstream and downstream straight pipe runs as indicated in the Plans and as directed by the manufacturer.

C. Install grounding rings and gaskets as required. Ground as directed by manufacturer.

D. Wall mount remote display in control building as shown in the drawings and as directed.

E. Provide shielded signal cable as recommended by manufacturer for the outputs. All signal cable from the flowmeter vault to control cabinet shall be installed in conduit. Provide minimum 3 feet of flexible conduit near metering tube.

F. Provide power to remote display (120 VAC) as shown in the drawings and as specified. Provide flexible conduit near converter.

G. The manufacturer or authorized factory representative shall provide a minimum of one (1) day training and startup service to ensure installation and operation as required.

H. Verify that flow reading is accurate using approved device and method.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for flow meter and other work in this section shall be included as the unit price for the Magnetic Flow Meter as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 13421 – LEVEL SENSING EQUIPMENT

PART 1  GENERAL

1.01  SECTION INCLUDES

A.  Float specs for emergency, redundant, and simple level sensing and controls as indicated on the plans.

B.  Ultrasonic level sensors for level control and level sensing and indicated and shown on the plans.

C.  Submersible pressure transducers for level control and level sensing and indicated and shown on the plans.

1.02  RELATED SECTIONS

A.  Division 16 – Electrical

B.  Division 17- Operational Strategies

1.03  SUBMITTALS

A.  Submittals shall meet the requirements of Section 01300.

PART 2  PRODUCTS

2.01  MANUFACTURERS & MODEL

A.  Level Floats

   1.  Wet well floats that are installed in the same well as a submersible level sensor are redundant backup devices. They will only be acted upon if the PLC or sensor fails. Two sets of floats shall be installed with the submersible level transducer.

   2.  Wet well floats, meter vault flood float, and check valve vault float shall be suspended, non-mercury, avocado style and shall open on liquid rise and close on liquid fall. They shall be UL rated, 120/240VAC. Each float shall include be tie-wrapped to a tether as shown on the drawings. Contractor shall also furnish one spare float. Floats shall be Flygt ENM-10, or equivalent.

B.  Submersible Level Transducer

   1.  Submersible level transducer shall be Waterpilot FMX 167 by Endress + Hauser (Model FMX 167-A4DFE2C3); or approved equal. Include Gore-Tex vented Junction Box. Include five extra weights (Order No. 52006153) with level transducer to prevent sideways motion.

2.02  SUBMERSIBLE TRANSDUCER CONSTRUCTION

A.  Submersible hydrostatic level transducer specifically designed for small bore applications and to meet the rigorous environments encountered in submersible water level measurements.

B.  Sensor to be constructed of 316 stainless steel or titanium, and EPDM or Viton. Parts in contact with water shall be NSF 61 approved.
C. Submersible Cable to be reinforced with Kevlar fibers to eliminate errors due to cable elongation. Cable to have a tensile strength of at least 200 pounds without elongation or failure. Manufacturer’s cable length shall be sufficient to run from the transducer to the wall mounted junction box without splices.

D. Submersible transducer shielded cable shall include an atmospheric pressure compensation tube with Teflon filter. A terminal junction box shall be included with each transducer. Terminal housing shall be NEMA 4x rated, constructed of polycarbonate, and shall include a Gore-Tex filter (Part No. 52006152). Desiccant filters or bellows will not be acceptable.

E. Specifications
   1. Full Scale Range – 0 to 30 feet H₂O (0 – 12.99 psi)
   2. Static Accuracy – ± 0.2 %FSO, per DIN EN 60770
   3. Compensated Temperature Range – 0 to 50°C
   4. Long-Term Stability – ± 0.1% FSO per year
   5. Excitation – 10 to 30 VDC
   6. Input Current – 20 mA max
   7. Output – 4 to 20 mA
   8. Zero Offset – ± 0.12 mA
   9. Outside Diameter – 0.87-inches max.

**PART 3 EXECUTION**

3.01 INSTALLATION
   - A. Install all level sensors at locations shown on drawings as indicated and detailed and to manufacturer’s specifications.
   - B. Ensure proper calibration for true and accurate water level (depth) readings at PLC.

**PART 4 PAYMENT**

- A. Payment for items described in this section shall be included within the lump sum price for the Electrical, Wiring, Panels, and Level Control as stated on the Bid Form. No additional payment will be made for this work.

**END OF SECTION**
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SECTION 15050 – BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 GENERAL INFORMATION

A. Contractors shall become informed of all conditions under which this work is to be done. No monetary allowance shall subsequently be made because of any errors due to not becoming informed and familiar with the project.

B. Data given in the specifications and on the drawings are as exact as could reasonably be identified. Their extreme accuracy is not guaranteed. Drawings and Specifications are for the assistance and guidance of the Contractor; exact distances, levels and grades will be governed by the confines or the existing building.

C. Mechanical materials shall be installed in a neat and workmanlike manner. Building and process piping, ductwork, and other conduits shall be properly secured and supported. Equipment shall be installed as specified and in conformance with the equipment manufacturer’s recommendations and instructions. Vibrating equipment shall be installed with suitable vibration isolators to protect equipment and supporting structures from long-term damage. Lack of detail in drawings or specifications shall not relieve the Contractor of his responsibility to properly install, secure and support equipment and appurtenances.

1.02 STANDARDS AND CODES

A. Applicable Federal, State, County and Local Codes and Standards are the minimum requirements for materials and labor practices not otherwise stated. Nothing in the Plans or Specifications shall be construed or are intended to permit materials or installation not conforming to the above referenced authorities. The “Oregon State Plumbing Code” shall govern building services piping and plumbing.

1.03 FEES

A. Contractor shall obtain and pay for all permits and fees required by governing agencies having jurisdiction over this work. Work shall not begin until proper building permits are obtained and posted.

B. Contractor shall secure and pay for all inspections and tests required by Governmental or Utility Codes or ordinances prior to, during, and at the completion of this work. Contractor shall coordinate required inspections at the proper times without causing delays in work or progress.

1.04 SUBMITTALS

A. Shop Drawings. Contractor shall submit five copies to Engineer to be reviewed prior to construction or installation of work. Including, but not limited to:

1. Process or special unit piping.
2. All mounting brackets, standoffs, and supports used for piping, valves, and all mechanical fixtures.
3. Special valves and equipment.
4. Soil and drain plumbing fixtures floor or wall mounting.
5. Other submittals as required in specific Division 15 Sections.
6. See also requirements of Division 1.
1.05 QUALITY ASSURANCE

A. Division 15 materials and equipment shall be installed by qualified workers with experience specific to the items being used and methods of installation being required in the work.

B. Contractor shall obtain manufacturer’s instructions for equipment and carefully review before performing work. Contractor shall also be familiar with referenced standards pertaining to installation methods and materials. Project drawings, specifications, approved shop drawings, and manufacturer’s instructions shall be kept on site and adhered to.

1.06 WARRANTY

A. The Contractor shall assume full responsibility for and warrant for one year (after final acceptance) the satisfactory performance of all mechanical systems.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 TESTING

A. Contractor shall make tests of any portion of the installation as required by Engineer to determine if it is in accordance with these specifications.

B. Should any piece of apparatus or any materials or work fail in any test immediately remove and replace. Portion of work replaced shall again be tested by Contractor with no additional cost to owner.

C. All piping to be tested before concealing.

D. All tests shall be made in the presence of the Engineer.

E. Testing of building plumbing

1. Test all new plumbing system in the presence of the Plumbing Inspector and the Engineer. Provide ample advance notice of test dates. Provide all equipment, material and labor necessary for inspections and tests and repair all work not passing tests. After repairs are made, tests shall be repeated until each entire system is found satisfactory to the above authorities. Carry out tests prior to concealing, insulating or backfilling over any piping. No exceptions will be made.

2. Provide all equipment, material and labor necessary for inspection and tests, and repair all work found defective. Test pressure gauges must be of high quality and properly certified. Provide safety equipment to prevent accidental over-pressurization. After repairs are made, repeat tests until entire systems are found satisfactory.

3. All domestic water pressure piping; Hydrostatic test 150 psi for a minimum of 2 hours without drop in pressure. Exclude hot water heater from test.

4. All DWV piping; fill system with water to a point not less than 10 feet above the highest point in the system being tested. Water shall be held at that level for a
period of not less than 30 minutes. The system shall prove leak free by visible means.

F. Hydrostatic Testing of Process Water Piping. Fill process piping with potable water to a pressure of 150 psig. System must hold test pressure for a minimum of 2 hours with no drop in pressure. All leaks shall be corrected.

3.02 CLEANING

A. Equipment, fixtures, piping and all other materials furnished under this Division shall be cleaned, free from all rust, scale and dirt before covering or painting, or systems put into operation.

B. After completion of the work, all debris shall be removed, leaving entire work complete and undamaged.

3.03 CUTTING AND PATCHING

A. Necessary cutting and patching for installation of plumbing system included in this work. Work shall conform to applicable portions of project specifications. No cutting of structural members without prior written approval by Engineer.

3.04 PAINTING

A. Pipes, and all fittings including hanger rods, etc., not of stainless steel, shall be primed and painted per Division 9.

B. Shop pre-assembled equipment shall conform to painting specifications - Division 9, and shall be "touched up" or repainted if damaged during construction.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for basic mechanical materials, methods and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.
SECTION 15060 – HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Piping shall be supported, in general, as described hereinafter and as shown by the pipe support details on the Drawings. Manufacturer's catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed. Special support and hanger details may be shown to cover typical locations where standard catalog supports are inapplicable.

B. The Contractor shall select and design all piping support systems within the specified spans and component requirements. Structural design and selection of support system components shall withstand the dead loads imposed by the weight of the pipes filled with water, plus any insulation. Commercial pipe supports and hangers shall have a minimum safety factor of 5.

C. The absence of pipe supports and details on any drawings shall not relieve the Contractor of the responsibility for providing them throughout the project per accepted practices.

D. All support anchoring devices, including anchor bolts, inserts and other devices used to anchor the support onto a concrete base, roof, wall, or structural steel works, shall be of the proper size, strength and spacing to withstand the shear and pullout loads imposed by loading and spacing on each particular support.

E. Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment. A pipe support or hanger shall be installed adjacent to each pipe fitting or in-line device such as a valve or meter for all piping larger than 4-inch.

1.02 REFERENCES

A. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel

B. ASTM A123 - Specification for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip

C. ASTM A653 - Specification for Steel Sheet, Zinc-Coated by the Hot-Dip Process

D. ASTM A1011 – Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability (Formerly ASTM A570)

E. MSS SP58 - Manufacturers Standardization Society: Pipe Hangers and Supports-Materials, Design, and Manufacture

F. MSS SP69 - Manufacturers Standardization Society: Pipe Hangers and Supports-Selection and Application


L. AISI – American Iron and Steel Institute

M. UL94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 QUALITY ASSURANCE

A. Hangers and supports used in fire protection piping systems shall be listed and labeled by Underwriters Laboratories.

B. Steel pipe hangers and supports shall have the manufacturer’s name, part number, and applicable size stamped in the part itself for identification.

C. Hangers and supports shall be designed and manufactured in conformance with MSS SP 58.

D. Supports for sprinkler piping, if required, shall be in conformance with NFPA 13.

1.04 SUBMITTALS

A. Detailed shop drawings of all supports, including support anchoring devices, shall be supplied with the submittals specified herein.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver material carefully to avoid breakage and scoring finishes. Do not install damaged equipment.

PART 2 PRODUCTS

2.01 MANUFACTURER AND TYPE

A. Pipe Floor Supports. Horizontal piping pedestal supports shall be adjustable supports attaching to flanges or pipe stanchion saddles with U-bolts or clamps as shown in drawings.

1. Supports shall have a neoprene liner to isolate the pipe from the support and protect the PVC piping.

2. Support pipe shall be Schedule 40 galvanized steel cut to proper length. Supports shall be galvanized. Anchor bolts to concrete shall be stainless steel.

3. Supports used in the wetwell shall utilize sch 40 stainless steel pipe and stainless steel base, threaded top and clamp. Pipe shall be cut to size on site. Support base, pipe and top shall be fully welded to form a one-piece rigid construction.

3. Floor Supports shall be Standon model C92 or approved equal.
B. Pipe hangers for copper and plastic piping shall be coated with a plastic or neoprene protective cover. No metal portion of a hanger, support, or brace shall contact pipe directly. Use proper upper attachments and rods as required.

C. Pipe Hangers for piping less than 8-inch diameter shall be B-Line B3172C with threaded rod, nuts and washers, or approved equal. Assembly shall be zinc plated. Install as shown in the drawings and as required.

D. Wall support/clamp shall be used where shown in drawings. Strut channel horizontal support with wall mount bracket. Galvanized finish. B-Line B3064 or approved equal.

E. Offset clamps shall be used where shown in drawings. Galvanized finish. B-Line B3148 or approved equal.

F. Piping clamps for board or panel mounted pipe, tubing or conduit shall be one-hole clamps, short straps, split-style clamps, or offset clamps as required. Provide any required furring or stand-offs necessary for clearances. Furring on PVC equipment boards, when required, shall be PVC.

G. Strut channel systems shall be used where indicated on the plans and as required for proper support of vertical and horizontal multiple piping runs and electrical raceways. The strut systems are further described as:

1. All strut channels shall be galvanized or epoxy coated. B-Line B22 or approved equal.
2. Stainless steel hardware and accessories shall be used.
3. Strut shall be 1 5/8” wide in varying heights and in combinations and arrangements as shown on the drawings.
4. Pipe clamps shall include rubber pipe cushions or isolation pads. B-Line Vibraclamp BVT or approved equal. Galvanized finish.

H. SPLIT-STYLE PIPE CLAMPS (Behringer Clamps)

1. Split-style pipe clamps shall be used where shown on the drawings and where this style provides the most suitable clamp for wall, panel, or ceiling mounting.
2. Split-style clamps include a base plate, a bottom and top “clamp half” constructed of polypropylene, and a top plate. The separate components are connected using through bolts. The resulting assembly tightly cradles a piping section between the two clamp halves.
3. Behringer clamps are available in standard and heavy duty. Heavy duty clamps are required when being attached to strut channel. For all other applications, standard clamps are acceptable, unless otherwise recommended by the manufacturer.
4. Split-style heavy duty clamps shall be manufactured by Behringer, or approved equal. Standard split-style clamps shall be manufactured by Behringer, Stauff, or approved equal.
PART 3    EXECUTION

3.01 PREPARATION

A. Verify piping is level, plumb and true. Verify proper wall blocking has been installed where wall connections are required. Location of supports shall be organized in such a manner as to not interfere with access and other work.

3.02 INSTALLATION

A. Unless noted otherwise on the Drawings, horizontal pipe support or hanger spacing and hanger rod sizing for pipe shall not exceed as follows:

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Maximum Distance Between Supports (feet)</th>
<th>Minimum Hangar Rod Size (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; and less</td>
<td>4’</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>2&quot; to 1-1/4&quot;</td>
<td>5.5’</td>
<td>3/8&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; to 3-1/2&quot;</td>
<td>6.5’</td>
<td>1/2&quot;</td>
</tr>
<tr>
<td>4&quot; to 5&quot;</td>
<td>7’</td>
<td>5/8&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>8’</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>8&quot;</td>
<td>8.5’</td>
<td>3/4&quot;</td>
</tr>
<tr>
<td>10&quot;</td>
<td>9’</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td>12&quot;</td>
<td>10’</td>
<td>7/8&quot;</td>
</tr>
<tr>
<td>14&quot;</td>
<td>15’</td>
<td>1”</td>
</tr>
</tbody>
</table>

B. The load rating for universal concrete inserts shall not be less than that of the hanger rods they support.

C. When supporting cast iron and ductile iron pipe, locate hanger rods near all joints and at each change of direction.

D. All piping shall be supported in a manner which will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supporters shall be provided at changes in direction or elevation, adjacent to flexible couplings, and where otherwise shown. Pipe supports and hangers shall not be installed in equipment access areas.

E. All supports and clamps shall be installed as necessary to provide a secure installation in a neat and workmanlike manner.

PART 4    SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for basic mechanical materials, methods and other work in this section shall be included as a portion of the lump sum price for the Ductile Iron Site Piping, valves and Fittings as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 15105 – PIPING SYSTEMS

PART 1  GENERAL

1.01 WORK INCLUDED

A. This Section specifies ductile iron, PVC, steel, stainless steel, copper, plastic tubing, and other piping systems to be used on the project.

B. Where indicated, the Contractor may choose a piping material. Otherwise, the material referenced will be required.

1.02 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and the listed documents, the requirements of this section shall prevail.

<table>
<thead>
<tr>
<th>References</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI B1.1-81</td>
<td>Unified Inch Screw Threads (UN and UNR Thread Form)</td>
</tr>
<tr>
<td>ANSI B1.20.1-83</td>
<td>Pipe Threads, General Purpose (Inch)</td>
</tr>
<tr>
<td>ANSI B16.1-89</td>
<td>Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800</td>
</tr>
<tr>
<td>ANSI B16.5-88</td>
<td>Pipe Flanges and Flanged Fittings</td>
</tr>
<tr>
<td>ANSI B18.2.1-81</td>
<td>Square and Hex bolts and Screws Inch Series Including Hex Cap Screws and Lag Screws</td>
</tr>
<tr>
<td>ANSI B18.2.2-87</td>
<td>Square and Hex Nuts</td>
</tr>
<tr>
<td>ASTM F104-88</td>
<td>Standard Classification System for Nonmetallic Gasket Materials</td>
</tr>
<tr>
<td>ASTM F152-87</td>
<td>Standard test Methods for Tension Testing of Nonmetallic Gasket Materials</td>
</tr>
<tr>
<td>AWWA C111-85</td>
<td>Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings</td>
</tr>
<tr>
<td>AWWA C207-86</td>
<td>Steel Pipe Flanges for Waterworks Service--Size 4 In. Through 144 In.</td>
</tr>
<tr>
<td>AWWA C213-07</td>
<td>Fusion Bonded Epoxy Coating for Interior and Exterior for Steel Water Pipes</td>
</tr>
</tbody>
</table>

1.03 RELATED SECTIONS

A. Section 15060 – Hangers and Supports
B. Section 15110 – Valves
C. Section 15120 – Misc. Fittings & Specialties

1.04 SUBMITTALS

A. Contractor shall submit 3 copies of technical data for project piping. Data shall include material data, pressure rating data, location of manufacture, and other information as necessary to show complete compliance with these specifications for each type of piping used.

B. If welded piping is to be used, submit detailed shop drawings showing dimensions, pipe sizes, field weld locations, flange locations, etc.

1.05 QUALITY ASSURANCE

A. All piping shall be new, unused and completely free from defects.

B. All pipe materials made in the USA shall be given preference.

1.06 PIPING SCHEDULE

A. Where not specifically noted on the plans or otherwise specified, pipe shall be installed in accordance with the following schedule and conform to the detailed specifications for each type of pipe.

B. Contractor may, at his own discretion and expense, furnish superior piping in material and pressure rating than that specified.

C. The following schedule (Table 1) is provided indicating the piping materials to be utilized on the project.

<table>
<thead>
<tr>
<th>Typical Location/Use</th>
<th>Material Spec.</th>
<th>Joint/Connections</th>
<th>Pressure Rating (min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw Sewer</td>
<td>SDR 26</td>
<td>Ductile Flanges,</td>
<td>150 psi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Megaflange,</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cast Iron Backer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Flanges for Stainless Piping</td>
<td></td>
</tr>
<tr>
<td>Drain Piping (1&quot; and larger)</td>
<td>Schedule 40 PVC</td>
<td>Glued</td>
<td>n/a</td>
</tr>
<tr>
<td>Force Main</td>
<td>HDPE DR11</td>
<td>Fusion</td>
<td>150 psi</td>
</tr>
<tr>
<td>Vent Piping</td>
<td>Stainless Steel</td>
<td>Welded</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**TABLE 1**  
**PIPING SCHEDULE**

**PART 2**  
**PRODUCTS**

2.01 PVC/CPVC PIPING, SCHEDULE 40 & 80

A. Schedule 40 PVC piping shall be manufactured from Type 1, Grade 1 polyvinyl chloride compound with a cell classification of 12454 per ASTM D1784.
B. Pipe shall be manufactured in strict compliance to ASTM D1785, consistently meeting and/or exceeding the quality assurance test requirements of this standard with regard to material, workmanship, burst pressure, flattening, and extrusion quality.

C. Fittings shall be injection molded, Schedule 40 or 80 (to match pipe schedule), manufactured in strict compliance to ASTM D2467 for socket type, and D2464 for threaded type. Use threaded fitting adapters only where specifically allowed as required to connect to valves. All threaded fittings shall have stainless steel reinforcements.

D. Pipe and fittings shall be NSF Standard 61 approved for use in potable water systems.

E. Cement shall conform to ASTM F493 and SCAQMD 1168. Cement shall be heavy-bodied, low VOC specifically recommended by the manufacturer for use in industrial sodium hypochlorite applications. Cement shall be IPS Weld-On 724 CPVC.

F. Primer shall conform to ASTM F656 and SCAQMD 1168. Primer shall be IPS Weld-On P-70, Purple.

G. Teflon tape shall conform to MIL spec P-27730A.

H. Piping shall be NSF approved.

2.02 DUCTILE IRON PIPING

A. Pipe shall be Ductile Iron Pipe (DIP), Grade 60-42-10 minimum, size and end configurations as shown in the drawings. Pressure Class 350 minimum thickness.

B. DIP shall be manufactured in accordance with ANSI/AWWA C151/A21.51 under method of design outlined in ANSI/AWWA C150/A21.50. Flanged sections shall also conform to ANSI/AWWA C115/A21.15.

C. Internal Lining. All ductile iron pipe shall be lined and seal coated with ceramic epoxy coating such as Protecto 401, factory applied. Dry film thickness shall be 40 mils nominal. Joint Compound (Protecto or equal) shall be applied by brush and in accordance with manufacturers recommendations.

D. External Coating. All DIP that will be buried or exposed to process water/wastewater on the pipe exterior shall be asphaltic seal coated on the exterior in accordance with ANSI/AWWA C151/A21.51. Interior DIP, and exterior DIP exposed to view and not subject to submergence, will require painting and may be supplied factory primed and without asphaltic coating.

E. Pipe shall be made in the USA and shall not have been refurbished or reworked by anyone other than the manufacturer.

F. Provide proper spool lengths from factory with plain and flange ends as required. If field cutting is required, follow manufacturer’s instruction and coat cut pipe end.

G. Pipe shall be manufactured by American Cast Iron Pipe Company, Pacific States Cast Iron Pipe Co., US Pipe, or approved equal.

2.03 DUCTILE IRON FITTINGS

A. Fittings shall conform to ANSI/AWWA C110/A21.10 Standard (full body), or ANSI/AWWA C153/A21.53 (compact), with a 250 psi minimum working pressure.
B. Where shown in the project drawings, provide bosses on fittings at locations shown.

C. Fittings shall be factory coated with ceramic epoxy on the inside, Protecto 401, or equal. Exterior of fittings shall have an asphaltic coating in accordance with ANSI/AWWA C110/A21.10. Fittings to be installed in building interior and painted shall be supplied with primer instead of asphaltic coating.

D. Mechanical joint fittings shall be produced in the USA in accordance with all applicable terms and provisions of ANSI/AWWA C153/A21.53 (or C110) and ANSI/AWWA C111/A21.11. MJ gasket material shall be SBR rubber. T-bolts shall be Cor-Ten or other approved high strength, low alloy steel in accordance with ANSI/AWWA C111/A21.11 (current revision).

E. Flanged fittings shall be manufactured in the USA of ductile iron in accordance with all applicable terms and provisions of ANSI/AWWA C110/A21.10. Flanged surface shall be faced and drilled in accordance with ANSI Class 125 B16.1. Nominal body thickness shall not be less than as specified in ANSI/AWWA C153/A21.53. Misalignment of bolt holes of two opposing flanges shall not exceed 0.125 inches.

1. Flange assembly bolts shall be ANSI B18.2.1 standard square or hexagon head carbon steel machine bolts with ANSI B18.2.2 standard hot pressed hexagon nuts. Threads shall be ANSI B1.1, standard coarse thread series; bolts shall be class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5. Flange assembly bolts and nuts shall be made of noncorrosive high-strength, low-alloy steel as specified in ANSI/AWWA C111/A21.11.

2. Flange gaskets shall be full-face with holes to pass bolts. Gasket material shall be neoprene rubber conforming to ASTM D2000, SAE J200, 1/8-inch thick.

F. Mechanical joints shall be positively restrained using MegaLugs, by EBAA Iron, or approved equal. Mechanical joints with retainer glands alone will not be acceptable on this project.

G. Flange and Mechanical Joint fittings shall be by Tyler Pipe, Union Foundry Company, US Pipe; or approved equal.

2.04 FIELD FLANGE FITTING

A. Restrained flange coupling adapters shall be used on the project in lieu of factory flanged spools only where indicated on the plans and approved.

B. Other types of field flanges will not be allowed on the project.

C. Restrained flanged coupling adapters shall be Mega-Flange by EBAA Iron, or approved equal.

2.05 STAINLESS STEEL VENT PIPING

A. Use where shown on drawings or as specified in Contract Documents.

B. Pipes shall be manufactured from ASTM A240 sheets and plates in accordance with ASTM A778 in 304L or 316L stainless steel.

C. Pipe minimum wall thickness shall be schedule 10S nominal.

D. Piping shall be provided in plain-end configuration in preparation for butt weld fittings.
E. Finish shall be No. 1 H.R.A.P. (Hot Rolled Annealed and Pickled) or better.

F. Fittings shall be butt weld type manufactured in accordance with ASTM-A-774 of the same grade (alloy) and in the same wall thickness as the pipe.

G. Fittings shall match pipe wall thickness. Minimum wall thickness shall be schedule 10S nominal.

H. Welding of pipe and fittings shall be performed using welders and procedures qualified in accordance with ASME Section IX. Piping and fittings with wall thicknesses up to and including 11 gauge (0.125”) shall be TIG welded. Heavier walls shall be beveled and TIG welded in multiple passes. Filler metal shall be of equal or superior grade to parent metal. Weld cross section shall be equal to or greater than parent material thickness. Weld concavity, undercut, cracks, crevices, or pitting shall not be allowed. Butt welds shall have full penetration to the interior surface.

I. After fabrication, exterior welds shall be manually scrubbed and/or brushed with non-metallic pads or stainless steel wire brushes to remove weld discoloration, rinsed with clean water and allowed to air dry.

J. Extreme care shall be taken to avoid contact between ferrous materials with the stainless steel piping. All saws, drills, files, grinders, brushes, etc. shall be used for stainless steel only.

K. Contractor shall paint all exposed steel or iron flanges, and other fittings, in accordance with Section 09900. Stainless steel pipe shall remain unpainted.

L. All markings shall be removed from stainless steel pipe by Contractor to provide a consistently clean surface.

2.06 BRASS/BRONZE FITTINGS

A. Red brass pipe nipples and piping shall be seamless, MIP threaded, rated for 150 psi working pressure, and conforming to ASTM B43 and ASTM B687. Bronze fittings shall meet the requirements of ASTM B62 with NPT threaded ends conforming to ANSI/ASME B16.15.

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure that piping is properly installed and supported. Verify end connections as required on the drawings. Verify dimensions required for installations.

B. Verify that piping has not been damaged in shipping or storage.

3.02 GENERAL INSTALLATION

A. Install piping per manufacturer’s instructions. Properly brace and support as directed.

B. Follow appropriate pipe joining specifications for various MJ, Flange, solvent welded and threaded ends.
C. All piping shall be cleaned and flushed prior to start of testing.

D. All piping shall be leak tested in accordance with Section 15050.

E. Potable water piping shall be flushed and disinfected in accordance with the requirement of the Oregon Department of Human Services, Drinking Water Program and OAR 331-061-050, and Section 15050.

3.03 FLANGED JOINT INSTALLATION

A. Furnish the gaskets required for each flange joint being assembled. Gasket material for flanged joints shall be 1/8-inch thick commercial neoprene sheet conforming to ASTM D2000, SAE J200 and 1 BC 609. For 12-inch and smaller pipe, gasket shall be full face cut with holes to pass bolts. For 14-inch and larger pipe, gasket shall be ring type.

B. Flanged joints shall be fitted so the contact faces bear uniformly on the gasket. Bolts shall be tightened progressively in a sequential, uniform manner to torque values recommended by the manufacturer of the flange or fitting. Flanged fittings shall be properly anchored, supported, or restrained during installation to prevent bending or torsional strains at the connection during and after the joining process.

3.04 MECHANICAL JOINT INSTALLATION

A. Joints and gaskets for mechanical joints shall conform to ANSI/AWWA C111/A21.11 Standard. Furnish gaskets and hardware necessary for each mechanical joint.

B. The pipe shall be inserted in the socket and supported as necessary to keep the pipe centered in the joint and to maintain uniform exposure of the gasket recess. The gasket shall be pressed firmly and evenly into the gasket recess prior to installing the bolts through the gland. Bolts shall be tightened progressively in a sequential, uniform manner to torque values recommended by the manufacturer of the fitting. The gland shall not be allowed to deform during the tightening process. Any required minor deflection of joints shall be made after the joint is assembled, but before final tightening of the bolts. The jointing procedure shall be repeated if effective sealing is not attained at the maximum torque. Bolts shall be tightened to manufacturer’s specifications. Bolts shall not be overstressed to compensate for ineffective sealing or poor installation practice.

3.05 PRESSURE TESTING

A. All pressure and leak testing shall be conducted by the Contractor in the presence of the Engineer.

B. Testing shall not be commenced until all thrust blocking has been in place for not less than 10 days and sufficient backfill has been placed to prevent pipe movement.

C. Test Procedure

1. The test section shall be filled with water and all air expelled from the pipe prior to testing. Contractor shall coordinate with the City to obtain water for testing.

2. All valves isolating the test section shall be securely closed and the specified test pressure applied by means of a pump connected near the lowest point of the test section. All open pipe ends shall be plugged using blind flanges or restrained plugs, as applicable.
3. The test pressure shall be 150 psi and the duration shall be at least 1-hour at the test pressure. No pressure drop is allowed during the test. No visible signs of leakage will be allowed at any exposed pipe, fitting or joint.

4. Contractor shall repair or replace any defective piping or fittings at no additional cost to the Owner. Repeat pressure tests until entire system is found satisfactory.

D. All visible leaks on new pipelines shall be repaired, regardless of the amount of leakage.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for piping systems, fittings and other work in this section shall be included as a portion of the lump sum price for the Ductile Iron Site Piping, Valves and Fittings as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

B. Payment for piping systems, fittings and other work in this section shall be included as a portion of the unit price for the Sewer and Forcemain as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 15110 – PIPELINE APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

A. The work in this Section consists of furnishing all labor, materials, equipment and performing all work necessary for the proper installation of pipe appurtenances indicated on the Plans and/or required for the completion of the proposed pump station and forcemain improvements.

B. Pipe appurtenances may include, but are not necessarily limited to the following:
   a. Fittings (bends, tees, etc.)
   b. Valves and Valve Boxes
   c. Concrete Thrust Blocking
   d. Anchor Wall

C. All water pipe fittings and appurtenances (including rubber gaskets) shall be made in the USA, shall be UL listed and FM approved.

D. Appurtenance Submittals – Three (3) copies of drawings and/or brochures for all appurtenances to be installed, whether as specified or a proposed substitution, shall be submitted to the Engineer for approval prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Ductile Iron Fittings

   1. Special note shall be taken of the various end configurations (MJ, flange, etc.) of fittings, valves, and other appurtenances as indicated in the Plans for various installation connections to existing and new materials. Thrust blocking as specified shall be installed at all fittings. Contractor may use full body or compact mechanical joint fittings, provided that the minimum pressure rating and other specifications are met.

   2. All bends, tees, crosses, reducers, caps, plugs, sleeves, connectors, laterals, “Y” branches, and all other non-valve fittings shall be Protecto 401 (or equal) lined in accordance with specification included in Section 02509-2.02 Interior Pipe Lining.

   3. Joints and gaskets for mechanical joint fittings shall be of domestic manufacture and conform to ANSI/AWWA C111/A21.11 Standard. Fittings shall conform to ANSI/AWWA C110/A21.10 Standard (full body), or ANSI/AWWA C153/A21.53 Standard (compact), with 250 psi working pressure minimum requirement. Furnish with ductile iron “T” head bolts and hexagonal nuts conforming to AWWA C111.

   4. Flanged fittings shall be faced and drilled to standard 125-pound template per ANSI B16.1 Standard, unless otherwise specified, indicated, or required to connect to other materials. Fittings shall conform to ANSI/AWWA C110/A21.10 and/or ANSI B16.1, Class 125, and be short-body style unless otherwise indicated. Flanged fittings shall have a 250 psi minimum pressure rating.
Gasket material for flanged joints shall be commercial neoprene sheet conforming to ASTM D2000, SAE J200, 1 BC 609, 1/8-inch thick. For 12-inch and smaller pipe, gasket shall be full face cut with holes to pass bolts. For 14-inch and larger pipe, gasket shall be ring type. Furnish with coarse thread cadmium plated nuts and bolts conforming to ANSI B18.2 and B1.1 American Standards for Class 2A and 2B fit. Stainless steel nuts and bolts will be allowed.

5. Mechanical joint and flange joint fittings shall be as manufactured by Tyler Pipe; Union Foundry Company; Pacific States Pipe; Stockham: U.S. Pipe; or approved equal.

6. Joint restrictors for MJ fittings shall be Megalug manufactured by EBAA Iron, Inc. designed specifically for pipe material used. Use on all mechanical joints.

7. All blind flanges for pipe of 12-inch diameter and larger shall be provided with lifting eyes in the form of welded or screwed eye bolts attached to the edge of the flange. Eye shall be located such that it is at the exact top center of blind flange when mounted on a horizontal pipe. Certification of eye tensile strength shall be provided.

B. HDPE Fittings

1. Fittings shall be PE 4710 HDPE, Cell Classification of 445574C as determined by ASTM D 3350. Butt Fusion Fittings shall have a manufacturing standard of ASTM D 3261. Electrofusion Fittings shall have a manufacturing standard of ASTM F 1055. Molded and fabricated fittings shall have the same pressure rating as the pipe and shall be tested in accordance with AWWA C 906.

2. Fabricated fittings are to be manufactured using a Data Logger. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records.

3. Flanged and Mechanical Joint Adapters - Flanged and Mechanical Joint Adapters shall be shall be used to connect HDPE pipe with other pipe materials. Flanged and Mechanical Joint Adapters shall have a manufacturing standard of AWWA C 906, ASTM D 3261.

4. HDPE Wall Anchor shall be fused to HDPE pipe at concrete wall anchor locations. HDPE wall anchor shall be DIPS HDPE wall anchor as manufactured by Performance Pipe; ISCO Industries or approved equal.

C. Couplings – All couplings shall be supplied with cadmium plated bolts or stainless steel bolts and other hardware conforming to nuts and bolts specified for flanged fittings. Contractor shall verify outside diameters (O.D.) of pipes to be connected prior to ordering couplings. Supply with standard shop coat enamel coating. Use only where specified on Plans.

1. Transition, reducing, and straight couplings, 2-inch through 12-inch, shall have cast ductile iron or carbon steel body, and resilient gaskets. TPS Hymax 2000 Series; Romac 501; or approved equal.

2. End caps couplings, 3-inch through 12-inch, shall have cast ductile iron sleeves, end rings and end caps, and resilient gaskets. Smigh-Blair 482; Romac EC501; or approved equal.
3. Flange coupling adapters, 3-inch through 12-inch, shall have cast iron body and end ring, and resilient flange and coupling gaskets. Smith-Blair 912; Romac FCA501; or approved equal.

4. Flange by mechanical joint (Flg x MJ) adaptors, 3-inch through 20-inch, shall have ductile iron bodies and joints conforming to applicable fitting specifications herein. Tyler; Union Foundry Co.; or other approved pipe/fittings manufacturer.

5. Couplings, ½-inch through 2-inch, for IPS pipe shall be compression type with rubber gaskets. Body shall be at least 3 ¾-inches long and constructed of galvanized carbon steel, with ASTM A 47 malleable iron nuts. Smith-Blair 522; Romac 702; or approved equal.

D. Galvanized Pipe Fittings – Galvanized pipe fittings shall be 150-pound standard malleable iron screwed fittings, rated for 300 psi non-shock cold water, oil or gas (W.O.G.) pressure minimum. Fittings shall meet Federal Specification WW-P-521, shall be UL listed and conform to:

<table>
<thead>
<tr>
<th>Material</th>
<th>ASTM A 197-87</th>
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<tbody>
<tr>
<td>Dimensions</td>
<td>ASA B16.3</td>
</tr>
<tr>
<td>Threads</td>
<td>ASA B2.1</td>
</tr>
<tr>
<td>Galvanizing</td>
<td>ASTM A 153-82(87)</td>
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</tbody>
</table>

E. PVC Drain Waste Vent Fittings – PVC molded DWV fittings shall be a minimum Schedule 40, solvent weld unless otherwise stated. Fittings shall be manufactured in compliance to ASTM D 2665, ASTM D3311, ASTM F 1866, ASTM D 1784 and shall be certified to NSF Standard 14 and the Uniform Plumbing Code.

F. Eccentric Full-Port Plug Valves

1. Eccentric Plug Valves shall be of the tight closing, resilient faced non-lubricating variety and shall be of eccentric design such that the valve’s pressure member (plug) rises off the body seat contact area immediately upon shaft readaptation during the opening movement. Valves shall be drip-tight at the rates pressure and shall be satisfactory for applications involving throttling service as well as frequent or infrequent on-off service. The valve closing member should rotate approximately 90° from the full-open to full-closed position and vice-versa.

2. The valve body shall be constructed of cast iron conforming to ASTM A 126, Class B. Body ends shall be flanged with dimensions, facing and drilling in full conformance with ANSI B 16.1, Class 125. Mechanical joint to meet the requirements of AWWA C111/ANSI A21.11.3.

3. Port shall be minimum 80% of full pipe area.

4. Valve plug shall be constructed of cast iron conforming to ASTM A126, Class B. The plug shall have a cylindrical seating surface that is offset from the center of the plug shafts. The plug shafts shall be integral. The portion of the plug in the valve body shall be fully encapsulated with Buna-N rubber. Rubber compound shall be approximately 70 (Shore A) durometer hardness. Rubber to metal bond must meet ASTM D-429-73 Method B.

5. Plug shaft seals shall be adjustable. All packing shall be replaceable without removing the bonnet or actuator and while the valve is in service. Shaft seals shall be Buna-N.
6. Manual valves shall have worm gear type actuators with handwheels or 2” square nuts.

7. Valve end configurations and sizes as shown on Plans.

8. Buried valves shall be furnished with a cast iron valve box as specified herein, and shall have operators designed for direct bury service. Furnish with a stem extension such that the operating nut is within 30-inches of the ground surface. Furnish hand wheel operators for all non-buried valves, including valves in vaults.

9. Valves shall be Clow, M&H, Kennedy; or equal.

G. Swing Check Valves (4” – 10”)

1. Swing Check valves, 4-inch through 12-inch, shall be iron body, full opening swing type. Valve clapper shall swing completely clear of the waterway when valve is full open, with open flow area equal to nominal pipe diameter.

2. Check valves, 4-inch through 12-inch shall be rated at 175 psi water working pressure and 350 psi hydrostatic test for structural soundness. Seat tightness at rated working pressure shall be in accordance with values shown in AWWA Standard C-500 for gate valve and fully conform to AWWA C508. Check valves shall be UL listed and FM approved.

3. Cast iron shall conform to ASTM-A-126 Class B. Casting shall be clean and sound without inclusion or defect that will impair service. Furnish with fusion bonded epoxy meeting ANSI/AWWA C550 standard.

4. Clappers shall be cast iron and rubber faced. Hinge pins shall be 18-8 stainless steel.

5. Check valves shall be constructed to permit top entry for complete removal of internal components without removing the valve from the line. Glands shall be O-ring type.

6. Check valves shall be equipped with external lever and adjustable weight. Provisions shall be included to allow addition of spring assist assembly in the field.

7. Check valves shall be equipped with external limit switches to indicate a “valve open” condition or “valve closed” condition. See Division 16.

8. Bosses shall be provided on check valves for NPT taps. Bosses shall be provided at locations conforming to the Manufacturers Standardization Society Specification SP-45-1953. For 10-inch check valves, provide 1 ½” NPT tap at locations C and D, as defined in SP-45-1953. Provide galvanized malleable iron, square head pipe plug, rated for minimum 125 psi and conforming to ANSI/ASME B16.4 and ASTM A126 Class A; or approved equal.

9. Check valve end configurations and sizes shall be as shown on the Plans.

10. Joint materials, nuts and bolts for mechanical and flange joints shall be as specified in Section 02514-2.01.A.

11. Check valves shall be manufactured in the United States.
12. Check valves shall be as manufactured by Clow; M&H; Kennedy, American Flow Control; or approved equal.

H. Bronze Gate and Globe Valves (½” Through 3”)

1. Bronze valves shall be Class 150 globe style or non-rising stem solid wedge gate style. Angle style where shown or required. Threaded or union bonnet. Threaded ends.

2. Body and bonnet shall be ASTM B61 or 62 bronze. Disc shall be bronze or Teflon. Handwheel shall be bronze or malleable iron. Stem shall be brass or copper-silicon bronze. Packing shall be non-asbestos Kevlar/Teflon or plastic/graphite.

3. Valves shall be manufactured by Red White Valve, Stockham, Kennedy; or approved equal.

I. Valve Boxes

1. Cast iron valve boxes with PVC extensions shall be furnished and installed with all buried gate valves. See standard detail drawing.

2. Valve box shall have a single piece top section and separate cover. Box and cover shall be manufactured from ASTM A48, Class 30 cast iron and shall be rated for H20 traffic loading. Cover shall have “S” or “SEWER” formed in the casting.

3. Box shaft shall be 18-inches long with a 7-inch I.D. and 7½-inch O.D. Top flange of box shall be 12-inches in diameter. Cover shall be 7¾-inch diameter.

4. A PVC extension shall be placed at the valve extending to within 6-inches of the ground surface. The cast iron valve box is placed over this PVC extension. The PVC section shall be 6-inch diameter PVC, ASTM D3034, SDR35.

5. A hole shall be drilled through the cast iron box section to bring a length of toning wire into the box in accordance with the standard detail drawing.

6. Valve box assemblies shall be set such that the completed assembly is straight and plumb. The completed valve box assembly shall be centered over the operating nut of the valve and shall not transmit shock or stress to the valve, operating nut, or valve operator extension. Valve box assembly shall be kept free of rocks and other debris for the duration of the project. Valve box assembly shall be set flush with finish grade during final surface finishing.

7. Cast iron valve boxes shall be Olympic Foundry, Inc. VB-910; or approved equal.

J. Thrust Blocks and Concrete Anchor Walls – Furnish and place thrust blocks, sized as shown on the Plans. Concrete shall conform to Oregon Standard Specifications Section 00440, Commercial Grade Concrete. Compressive field strength shall not be less than 3,000 psi at 28 days. Maximum aggregate size shall be 1½-inches. Slump shall be between 2 and 4 inches. Thrust blocking shall be placed between undisturbed earth and the waterline fitting to be anchored in such a manner that the fitting is accessible for repair and nuts and bolts are not encased. 6 mil thick plastic sheeting shall be placed
between fittings and poured concrete. Thrust blocks shall be neatly formed with plywood. Contractor shall install as required to prevent lateral movement and uplift.

1. Concrete anchor walls shall be formed and centered midway within the walls as shown on the Plans, HDPE wall anchor shall be incorporated into the concrete wall anchor.

2. Reinforcing bars shall be placed as shown in the Detail drawings and Plans and shall be of deformed, billet steel conforming to ASTM A615, grade 60.

3. Adequate spacing shall be provided between the concrete cutoff wall and the nearest fitting to keep all joints, bolts, and nuts free of concrete.

4. The size of thrust block shall be determined by the size, configuration, and location of the piping. Minimum bearing areas for thrust restraint are outlined in the standard details. The contractor shall not increase the size of the bearing area or volume of concrete without the approval of the Engineer. Thrust blocks with volumes of concrete that are in excess of or less than that specified for the size and configuration of the piping shall be removed by the contractor, at the contractor's expense, when directed to do so by the Engineer.

5. Concrete gravity blocking is not permitted under any circumstances.

6. Concrete shall cure for a minimum of five (5) days prior to hydrostatic testing.

**PART 3 EXECUTION**

3.01 WORKMANSHIP

A. Fitting Installation – Install fittings at the location shown or as directed by the Engineer. Handle, clean, lubricate and install fittings as specified in the appropriate sections for laying pipe. Where a cut in the pipe is necessary for inserting fittings or closure pieces, cut the pipe mechanically without damaging it or its lining and leave a smooth end at right angles to the centerline of the pipe. Dress and bevel the cut end of the pipe to remove sharp edges and projections which may damage the gasket. Any lining or coating damaged to a significant degree during the cutting process, as determined by the Engineer, shall be cause for removing the damaged section by recutting the pipe or for rejecting the pipe altogether. On the pipelines, securely anchor all tees, plugs and elbows as shown or directed to prevent movement due to thrust. Achieve anchorage only by use of approved thrust blocking or approved joint restraint.

B. Valves – Set valves in the same manner as specified in Section 02315 for pipe. Clean the face of flanges thoroughly before assembling the flanged joint. Insert the gasket and tighten the nuts uniformly around the flange. Align pipe carefully on both sides of the valve before final tightening of the flanges to avoid stressing the valve body. After installation, operate the valve from full open to full closed to ensure proper operation of the valve. Correct any malfunction in the operation of the valve. Test valve joints with adjacent pipeline. Repair any leaks as observed around the valve. Backfill around valves as specified in Section 02315 for pipe.

C. Valve Boxes – Center valve boxes and set plumb over the operating nut of the valve. Set valve boxes so they do not transmit shock or stress to the valve. Set valve box covers flush with the surface of the finished pavement or such other level as may be directed. Adjust the extensions to the proper length as required for proper installation. Backfill shall be as specified for the connecting pipeline. Correct any misalignment of valve boxes without additional expense to the Owner. Drill a minimum 3/8" hole in the wall of
the upper section of the valve box, 1-inch to 2-inches below the bottom of the cover, and pass the locator wire through the hole.

D. Thrust Blocking and Anchor Walls—Provide thrust blocking, as shown or directed by the Engineer, using concrete as specified. Place the concrete blocking between undisturbed earth and the fitting to be anchored. The bearing surface shall be sized and located to adequately withstand the applied thrust force. Do not encase pipe joints or fittings with concrete. See the Plans for thrust block configurations. Install concrete anchor walls to secure HDPE pipe in place and allow for connection to new or existing waterlines other than HDPE pipe. Secure flex restraint or wall anchor to HDPE pipe following manufactures recommendations. Thrust blocks and anchor walls shall not be backfilled for a minimum of 12 hours unless approved by Engineer. Contractor shall provide suitable steel plating and pinning as required to cover the thrust blocks and anchor walls until backfill material may be placed.

**PART 4 SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Measurement and payment for fittings, including but not limited to Valves, Tees, Elbows, End Caps, Couplings, Adapters, Sleeves, Valve Boxes and Blind Flanges shall be included within the unit price for the Sewer and Forceemain Pipeas stated on the Bid Form. No separate or additional payment will be made for nuts, bolts, washers and other fitting related hardware or supplies. Payment for fittings shall include compensation for thrust and resistance blocking and connection to new forcemain. No additional measurement for this item will occur.

**END OF SECTION**
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SECTION 15113 – VALVES AND PROCESS CONTROL

PART 1  GENERAL

1.01  WORK INCLUDED

A. This Section specifies specialty valves used in the project.

B. Work includes furnishing, installing, testing, and adjusting valves for proper installation and operation.

C. Valve type, size and material for each application shall be as shown in the Plans and specified herein.

1.02  QUALITY ASSURANCE

A. All valves shall be new, unused and completely free from defects.

B. All valves of similar type shall be by a single manufacturer.

1.03  VALVE END CONFIGURATIONS

A. Valve end configurations shall be as shown in the drawings and required for the intended application.

B. Flanged valves shall be manufactured in accordance with ANSI B16.1 Class 125/150, including facing, drilling and flange thickness.

PART 2  PRODUCTS

2.01  WASTEWATER COMBINATION AIR VALVE

A. Wastewater combination air valves shall be automatic float operated valves designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure. The valve shall perform the functions of both wastewater air release and wastewater air/vacuum valves and furnished as a single body or dual body type as indicated on the plans.

B. Single body valves 4 inch and smaller shall have full size NPT inlets and outlets equal to the nominal valve size with a 2 inch inlet on 1 inch valves. The body inlet shall be hexagonal for a wrench connection. The valve shall have 3 additional NPT connections for the addition of backwash accessories.

C. Single body valve shall provide an extended body with a through flow area equal to the nominal size of the valve. Floats shall be unconditionally guaranteed against failure including pressure surges.

D. Single body valves shall have a full port orifice, a double guided plug, and an adjustable threaded orifice button. The plug shall be protected against direct water impact by an internal baffle and an extended float stem. The plug shall have a precision orifice drilled through the center stem. The float shall include a sensitivity skirt to minimize spillage.
E. Valve body and cover shall be cast iron. Float, plug, guide shafts, and bushings shall be constructed of Type 316 stainless steel.

F. Backwash accessories shall be furnished and shall consist of an inlet shut-off valve, a blow-off valve, a clean water inlet valve, rubber supply hose, and quick disconnect couplings. Accessory valves shall be quarter turn, full ported bronze ball valves.

G. Valve interior and exterior shall be coated with fusion bonded epoxy.

H. Valve shall have 2” NPT inlet and 1” NPT outlet.

I. Valve shall be Val-Matic Series 801A, or approved equal.

2.02 PVC/CPVC BALL VALVES

A. Ball Valves. Industrial Grade True Union Ball Valves with Teflon seats and EPDM O-rings. Double block design stopping flow in both directions allowing removal of downstream union for service. 225 psi non-shock working pressure min. Threaded and socket ends. Size as indicated on the drawings. NSF listed for potable water. Spears, Hayward, Plast-O-Matic, or approved equal.

2.06 ECCENTRIC FULL-PORT PLUG VALVES

A. Eccentric Plug Valves shall be of the tight closing, resilient faced non-lubricating variety and shall be of eccentric design such that the valve’s pressure member (plug) rises off the body seat contact area immediately upon shaft readaptation during the opening movement. Valves shall be drip-tight at the rates pressure and shall be satisfactory for applications involving throttling service as well as frequent or infrequent on-off service. The valve closing member should rotate approximately 90° from the full-open to full-closed position and vice-versa.

B. The valve body shall be constructed of cast iron conforming to ASTM A 126, Class B. Body ends shall be flanged with dimensions, facing and drilling in full conformance with ANSI B 16.1, Class 125. Mechanical joint to meet the requirements of AWWA C111/ANSI A21.11.3.

C. Port shall be minimum 80% of full pipe area.

D. Valve plug shall be constructed of cast iron conforming to ASTM A126, Class B. The plug shall have a cylindrical seating surface that is offset from the center of the plug shafts. The plug shafts shall be integral. The portion of the plug in the valve body shall be fully encapsulated with Buna-N rubber. Rubber compound shall be approximately 70 (Shore A) durometer hardness. Rubber to metal bond must meet ASTM D-429-73 Method B.

E. Plug shaft seals shall be adjustable. All packing shall be replaceable without removing the bonnet or actuator and while the valve is in service. Shaft seals shall be Buna-N.

F. Manual valves shall have worm gear type actuators with handwheels or 2” square nuts, as indicated on the plans.

G. Valve end configurations and sizes as shown on Plans.

H. Buried valves shall be furnished with a cast iron valve box as specified herein, and shall have operators designed for direct bury service. Furnish with a stem extension such that the operating nut is within 30-inches of the ground surface. Furnish hand operators as shown on Plans.
I. Valves to be matched with electric motorized actuators shall be provided and set up for mechanical and automated actuation.

J. Valves shall be Val Matic, Clow, M&H, Kennedy, Pratt; or equal.

2.07 DUCKBILL VALVE 2"

A. Contractor shall install 2" duckbill valve to valve vault drain piping.

B. Duck bill valve shall be TideFlex Series TF-2 or approved equal. Claps shall be stainless steel.

PART 3 EXECUTION

3.01 PREPARATION

A. Ensure that piping is properly installed and supported. Verify valve end configurations required with the drawings. Verify dimensions required for valve installations. Verify proper manual operators, extensions, etc. are on-site for valve operation.

B. Verify that valves have not been damaged in shipping or storage and are operating correctly.

3.02 INSTALLATION

A. Install valves per manufacturer’s instructions. Properly brace and support valves.

B. Follow appropriate pipe joining specifications for various MJ, Flange, solvent welded and threaded ends.

C. Flush all pipelines prior to valve operation to remove all grit.

D. Operate all valves after installation to ensure smooth and proper operation. Adjust, clean, and lubricate as required.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Valves, Process Control and other work in this section shall be included as a portion of the lump sum price for the Ductile Iron Site Piping, valves and Fittings as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 15115 – PIPE PENETRATION SLEEVE AND SEALS

PART 1  GENERAL

1.01 SUMMARY

A. The work in this Section consists of furnishing all labor and materials, and performing all work necessary for the proper installation of annular space seals.

1.02 REFERENCES

A. Section 03300 – Cast-In-Place Concrete
B. Section 02501 – Ductile Iron Pipe and Fittings

1.03 SUBMITTALS

A. Submit product data in accordance with Section 01300.

1.04 PROJECT CONDITIONS

A. Verify all relative dimensions, pipe outside diameter and required sleeve inside diameter, before ordering product. Contractor is responsible for product fitment and function.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 1 Product Requirements Sections.
B. Ordering: Comply with manufacturer’s ordering instructions and lead time requirements to avoid construction delays.
C. Delivery: Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact. Sequence deliveries to avoid delays and minimize on site storage.
D. Storage and Protection: Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by the Manufacturer. Protect from sunlight, weather, excessive temperatures and construction operations.

PART 2  PRODUCTS

A. MODULAR SEALS FOR PIPE PENETRATIONS

a. Annular space between the pipe and wall shall be sealed by use of modular seals consisting of interlocking synthetic rubber links shaped to continuously fill the annular space.

b. The elastomeric element shall be sized and selected per manufacturer’s recommendations and have the following properties as designated by ASTM.

c. Coloration shall be throughout elastomer for positive field inspection. Each link shall have a permanent identification of the size and manufacturer’s name molded into it.

d. Modular seal links shall be black EPDM rubber suitable for use in untreated wastewater.
e. Modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties: Izod Impact – Notched = 2.05 ft-lb/in. Per ASTM D-256, Flexural Strength @ Yield = 30,700 psi per ASTM D-790, Flexural Modulus = 1,124,000 psi per ASTM D-790, Elongation break = 11.07% per ASTM D-638. Specific Gravity = 1.38 per ASTM D-792.

f. All fasteners shall be 316 stainless steel per ASTM F593-95 with 85 ksi average tensile strength.

g. Modular link seals shall be manufactured by PSI-Thunderline/Link-Seal, or approved equal. Modular seal links and modular seal pressure plates shall be products of the same manufacturer.

h. Link-Seal models LS200, 275, 300 and 315 shall incorporate the most current Link-Seal Modular Seal design modification sand shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which shall permit increased compressive loading of the rubber sealing element.

i. Link-Seal models 315, 325, 340, 360, 410, 425, 475, 500, 575, and 600 shall incorporate an integral recess designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware.

B. FLEXIBLE CONNECTORS FOR PIPE PENETRATIONS

a. Connections to precast riser gravity sections shall be accurately core-drilled and shall utilize a properly sized flexible rubber boot providing a watertight seal. Adapter shall be factory tested for watertightness up to 10.8 psi. Kor-N-Seal 106 series as manufactured by NPC, Inc. or approved equal.

b. Connectors shall use stainless expansion bands, 8-inches in length.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install per manufacturers recommendations and per contract drawings.

B. Modular seals shall not be allowed to bear the weight of pipe, either during installation or anytime thereafter. Proper pipe supports shall be supplied where appropriate.

C. Center the pipe in wall opening, making sure to properly support the pipe at both ends.

D. Insert Modular Seal according to Manufacturer recommendations, do not add or remove links from the seal to reduce or increase “sag”.

E. Tighten bolts starting at the 12 O’ Clock position and continue in a clockwise pattern. Do not tighten any bolt more than 4 turns at a time. Continue the clockwise pattern until all links are uniformly compressed. Do NOT use electric or pneumatic tools to tighten bolts, hand tighten only, follow manufacturers recommendations. Tighten until modular sealing elements “bulge” around the pressure plates.

F. For questions regarding installation of Link-Seal modular seals call (800) 423-2410.

G. Flexible connectors shall be installed using hand tools utilizing a ½” socket wrench and preset torque limiter to 12 foot lbs.
H. Pipe shall be smooth and inserted into the center of the connector opening and clamped to 60 inch pounds of force.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for pipe penetration seals and other work in this section shall be included as a portion of the unit price for Sewer and Forcemain Pipe as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 15120 – MISCELLANEOUS FITTINGS AND APPURTENANCES

PART 1  GENERAL

1.01  WORK INCLUDED

A. This section contains specifications for miscellaneous fittings, components, and appurtenances that are required to provide complete installations for a number of systems required on the project.

B. Items specified in this Section include:

1. Floor drain assembly
2. Hose Bibb

1.02  RELATED SECTIONS

A. Section 15105 – Piping Systems

1.03  SUBMITTALS

A. Submittals shall meet the requirements of Section 01300.

PART 2  PRODUCTS

2.01  FLOOR DRAINS

A. Drain with grate to be installed in valve vault. Drain shall be connected to a 2-inch drain pipe.

B. Drain body shall be designed to be cast into concrete floor and shall have a threaded connection for pipe. Body to be epoxy coated cast iron with bottom outlet, and flat corrosion resistant grate.

C. Install at location shown on the drawings. Install such that top of grate is 1/8 inch below surrounding concrete slab surface.

D. Floor drain shall be Zurn Z551; or equal.

2.02  HOSE BIBB

A. Hose Bibb body shall be of Cast Bronze ASTM B584 with stainless Steel 300 series fasteners.

B. Hose Bibb shall have a maximum working pressure 125 psi and maximum working temperature 140 degrees.

C. Hose Bibb shall be Wilkins 195 series; or equal.

D. Hose Bibb shall be freeze proof or contractor shall supply cover.

PART 3  EXECUTION

3.01  INSTALLATION
A. Install all equipment per manufacturer’s recommendations and instructions.

B. Installation shall be performed in the arrangement and position as shown on the drawings.

**PART 4 SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Payment for fittings and appurtenances and other work in this section shall be included as a portion of the lump sum price for the Control Building as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 15762 – CABINET, UNIT AND WALL HEATERS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Work in this section includes furnishing and installing the hvac mini split system required on the project.

B. Heaters for this project include: HVAC mini split system.

1.02 RELATED SECTIONS

A. Division 16 - Electrical

1.03 SUBMITTALS

A. The Contractor shall submit 3 copies of specific brochure data for each heater proposed showing electrical characteristics, construction, features, dimensions, mounting details, and control details.

PART 2 PRODUCTS

2.01 UNIT HEATER

A. Unit shall be capable of cooling an heating to 32 degrees- 86 degrees.

B. Unit shall be 12,000 BTU min split system with voltage at 120 V, three phase unit.

C. Unit shall be installed per manufactures recommendations.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install heaters and accessories in accordance with the manufacturer’s instructions and NEC.

B. Properly secure and support, support bracket as required. Position as shown in detail drawings.

C. Coordinate with Owner when options for mounting locations and thermostat locations exist.

D. Test heater controls for proper operation. Set thermostats as directed.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Furnish materials and provide work in this Section as a portion of the lump sum price for the Control Building as stated in the Bid Form. No separate payment will be made for work in this Section.
END OF SECTION
SECTION 15810 – DUCTWORK

PART 1  GENERAL

1.01 WORK INCLUDED

A. Work in this section includes furnishing and installing all ductwork and accessories as shown on the Plans and specified, including but not limited to, ductwork, manufactured duct joints, casings, and flexible duct fan connections as applicable.

1.02 RELATED SECTIONS

A. Section 15830 – Fans

1.03 REFERENCES

C. ASTM A90 – Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
D. ASTM A525 – General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
E. ASTM A527 – Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
F. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
G. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.
H. SMACNA – Duct Construction Standards.
I. UL 181 – Factory-Made Air Ducts and Connectors.
J. UL 555 – Fire Dampers, UL 555C & UL 555S.
K. Uniform Mechanical Code
L. Uniform Building Code

1.04 SUBMITTALS

A. The Contractor shall submit 3 copies of shop drawings for the proposed ductwork layout showing plan; elevation; cross-sections; and indicating the locations of all fabricated fittings, including dampers, flexible connections, taps, and reducers.

1.05 DESIGN REQUIREMENTS

A. Ductwork

1. Design ductwork in accordance with ASHRAE and SMACNA guidelines and standards.

2. All duct construction, including sheet metal gage and reinforcement, shall follow the SMACNA HVAC Duct Construction Standards, latest edition, unless otherwise noted.

3. Ductwork for special exhaust systems shall conform to NFPA 91 and the Uniform Mechanical Code.

4. All ductwork shall be insulated to R-11 minimum.

B. Sound Attenuation – Ductwork shall be designed such that air noise and vibration are kept to a minimum.
C. Air Leakage – Comply with applicable duct sealing requirements as listed in SMACNA HVAC Duct Construction Standards.

D. Flexible Duct Fan Connections
   1. Provide at least one-inch slack in connections to insure that no vibration is transmitted from fan to ductwork.
   2. Exhaust ducts shall have flexible connections appropriate for the type of exhaust and NFPA/UMC requirements.

E. Elbows
   1. Elbows with throat radius (measured at inside surface) equal to duct depth should be used wherever possible. Rectangular elbows are discouraged. If rectangular elbows are needed, they shall have single-wall turning vanes, with intermediate supports if the length of the vanes exceeds 36-inches. Edges of the turning vanes shall be parallel with the sides of the elbow.

PART 2 PRODUCTS

2.01 MATERIALS
   A. General – All duct materials shall be non-combustible or conforming to requirements for Class 0 or Class 1 air duct materials, per UL 181 with limitations as noted in NFPA 90A.
   B. Steel Ducts – Steel ducts shall be formed of ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz. per sq. ft. for each side in conformance with ASTM A90.
   C. Sealant – Duct sealant shall consist of non-hardening, non-asbestos, water resistant, UL classified fire resistive sealant compatible with mating materials.

2.02 MANUFACTURED JOINTS
   A. Manufactured duct joints shall consist of components of standard catalog manufacture and shall be of same brand as the duct system being installed, or approved equal.
   B. Manufactured duct joints shall be formed of equal gauge metal as duct system, or as recommended by manufacturer.

2.03 FLEXIBLE CONNECTORS
   A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.
   B. Flexible connectors shall be fire-resistant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
   C. Fabric shall be minimum 30 oz. per sq. yd. density, crimped into metal edging strip.

2.04 EAVE CAPS FOR EXHAUST FAN AND FRESH AIR INTAKE
A. Inlet/Outlet caps for exhaust fan shall form an airtight seal to the ducting. Caps shall have bird screens,

B. Inlet/Outlet caps shall be mounted on outside walls as shown in drawing.

C. Inlet cap shall be stainless steel down facing hood, with a 6 inch round duct connector, stainless bird/insect screen, and inlet damper.

D. Outlet cap shall be stainless steel down facing hood, with a 6 inch round duct connector, stainless bird/insect screen, and outlet damper.

**PART 3  EXECUTION**

3.01 INSTALLATION

A. Install ducting and accessories in accordance with applicable portions of SMACNA HVAC Duct Construction Standards and as indicated on the approved shop drawings.

B. Properly secure and support all ductwork and accessories.

**PART 4  SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Furnish materials and provide work in this Section as a portion of the lump sum price for the Control Building as stated in the Bid Form. No separate payment will be made for work in this Section.

**END OF SECTION**
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# DIVISION 16000 – ELECTRICAL
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SECTION 16050 – BASIC ELECTRICAL MATERIALS AND METHODS

PART 1  GENERAL

1.01 SUMMARY

A. Contractor shall conform to the General Conditions, Supplementary General Conditions, and related work in all other divisions and all work in Division 16. Correlation of contract requirements is the responsibility of the Contractor.

B. The Contract Documents are complimentary. What is required by any one, as affects this Division, shall be as binding as if repeated therein.

C. Electrical Sub-Contractor is expected to review and be familiar with Mechanical Drawing Sheets and Division 11, 13 and 15 Specifications.

D. Separation of this Division from other Contract Documents shall not be construed as complete segregation of the work nor shall it suggest a scope of work for a Contractor or subcontractor.

E. Particular attention is called to the Bidding Information, Conditions of the Contract, and Special Specifications.

F. All deviations from the Drawings or Specifications must be approved, in writing, by the Engineer and the Owner.

1.02 WORK INCLUDED

A. It is the intention of this Section of the Specifications and the accompanying drawings to describe and provide for the furnishing, installing, testing and placing in satisfactory and successful operation all equipment, materials, devices and necessary appurtenances to provide a complete electrical system, together with such other miscellaneous installations and equipment hereinafter specified and/or shown on the Plans. The work shall include all materials, appliances and apparatus not specifically mentioned herein or noted on the Plans, but which are necessary to make a complete working installation of all electrical systems shown on the Plans and described herein. Certain equipment and devices furnished and installed under other Divisions of this Contract (or by Owner) shall be connected under this Division. The drawings and specifications are complimentary and what is called for in either is as binding as if called for in both. To restate: Contractor is responsible for connecting all electrical equipment in this project, even if the connections are not described or detailed on the drawings or specifications.

B. Provide equipment and installation not otherwise shown on the drawings but required by code or required to make a complete and functional electrical system.

C. Contractor shall offer electrical assistance to all other contractors.

1.03 WORK NOT INCLUDED

A. Equipment furnished and installed under another Division. However, electrical connection of equipment installed or furnished under another Division shall be the responsibility of the Division 16 contractor unless the task is specifically assigned in the Division documents to another contractor.

1.04 DIVISION 16 WORK DESCRIBED IN OTHER DIVISIONS INCLUDES:
A. Temporary Power. See General Requirements.

B. Mechanical control wiring and alarm wiring. See pertinent Divisions.

C. Equipment control wiring. See Division 11 and Division 13.

D. Electrical connection to all new equipment and interconnections with existing facilities, whether detailed on plans or not, is a responsibility of the Division 16 contractor.

1.05 EXAMINATION OF SITE

A. The Contractor shall visit the premises to thoroughly familiarize himself with all details of the work and working conditions and verify all dimensions in the field, and shall advise the Engineer of any discrepancy before permitting the work. The Contractor shall be specifically responsible for the coordination and proper relation of the electrical work to the building structure and to the work of other trades.

B. Owner shall not be responsible for any loss of unanticipated costs which may be suffered by the successful bidder as a result of such bidder's failure to fully inform himself in advance in regard to all conditions pertaining to the work and character of the work.

C. Field-verify scale and dimensions shown on all contract documents and drawings, since exact locations, distances and levels shall be governed by actual field conditions.

1.06 PROTECTIVE AND ACCESS REQUIREMENTS

A. Protection. Exposed parts that are subject to high operating temperatures or are energized electrically and moving parts of which are of such nature or so located as to be a hazard to operating personnel, shall be insulated, fully enclosed or guarded. Guarding shall be arranged in a manner that will not impair the proper functioning of these parts.

B. Access. Where equipment is more than 8 feet above the floor, steel platforms and ladders shall be provided where required to permit easy access for inspection and maintenance.

1.07 COORDINATION

A. The Division 16 Contractor shall coordinate his work with that of the other Contractors doing work in the buildings and shall examine all drawings, including the several Divisions of mechanical, ventilation, structural and general, for construction details and necessary coordination.

B. Special attention shall be given for the following items and all conflicts shall be reported to the Engineer before installation for decision and correction:

1. Location of radiators, grilles, pipes, ducts and other mechanical equipment so that all electrical outlets, lighting fixtures and other electrical outlets and equipment are clear from and in proper relation to these items.

2. Within the limits indicated on the drawings, the maximum practicable space for operation, repair, removal and testing of equipment shall be provided.

C. The Contractor will not be paid for cutting, patching and finishing required for relocation of work installed due to interference between the various Contractors' work.
D. Composite Interference Drawings. Before any sleeves or inserts are set or any electrical equipment or foundations are installed, prepare and submit for approval, by the Engineer, in accordance with the General Provisions, composite coordination drawings for all equipment rooms, spaces and other areas in which the probability of interference exists. Drawings shall show the work of all trades covered, shall be drawn to a scale not smaller than 1/2" = 1'-0", and shall show clearly in both plan and elevation that all work can be installed without interference.

E. Prior Installation. Any electrical work installed prior to approval of coordination drawings shall be at the Contractor's risk. Subsequent relocations required to avoid interferences shall be made without additional expense to the Owner. In case interference develops, the Engineer will decide which work shall be relocated, regardless of which was installed first.

F. Outages. Schedule any power or communication outages which may affect existing facilities with the Owner and Engineer.

1.08 CODES AND STANDARDS

A. If any conflict occurs between government adopted code rules and this Specification, the codes are to govern. Nothing in these drawings and specifications shall be construed to permit work not conforming with governing codes. Also, this shall not be construed as relieving the Contractor from complying with any requirements of the plans or specifications which may be in excess of requirements of the hereinbefore mentioned rules and not contrary to same.

B. All electrical equipment shall bear the label of the testing laboratories recognized by the State of Oregon as meeting the testing standards for minimum electrical safety.

C. All electrical systems shall be designed to the following current National Standards. The Contractor is required to familiarize himself with the detailed requirements of these standards and any local codes and ordinances as they affect the installation of specific electrical systems.

1. National Electrical Code (NEC)

2. Uniform Building Code (UBC) as applicable.

D. Comply with State and any local electrical codes, safety orders, ordinances, applicable building codes, and requirements of serving utilities.

E. Materials shall, where rated, be UL listed and conform to applicable ANSI, NEMA, ISA and OSHA, or other recognized standards.

F. Design features specified or shown which are over and above requirements of relevant codes and standards shall take precedence.

1.09 PERMITS AND FEES

A. The Contractor shall obtain and pay for all licenses, permits and inspections required by laws, ordinances and rules governing work specified herein. The Contractor shall arrange for inspection of work by the inspectors and shall give the inspectors all necessary assistance in their work of inspection. Contractor shall make all necessary arrangements for installation of electrical services indicated on plans.
B. Contractor shall pay all communications, security and power company fees and/or costs for power installation, regardless if provided overhead, underground or rerouted.

1.010 CONTRACT DRAWINGS

A. Conduits and ground connections are shown diagrammatically only and indicate the general character and approximate location. The layout does not necessarily show the total number of conduits for the circuits required, nor are the locations of indicated runs intended to show the actual routing of the conduits. The Contractor shall furnish, install and place in satisfactory condition, ready for operation, all conduits, cables and other materials required for a complete electrical system.

B. The horsepower of motors and apparatus wattages indicated on the plans and in the panel schedules are estimated requirements of equipment furnished under other Divisions of this contract and bid shall be based on these sizes. Overload elements, contactors, circuit breakers, fuses, conductors, etc., shall be furnished to suit actual equipment installed. Advise Engineer of any equipment changes affecting electrical circuits.

C. Any minor changes in the location of the conduits, outlets, etc., from those shown on the plans shall be made without extra charge, if so directed by the Engineer before installation.

D. Contractor shall consult the architectural drawings for the exact height of all outlets not specified herein or on the drawings.

E. Outlet locations shown on the drawings are approximate. Contractor shall study the building drawings in relation to spaces and equipment surrounding each outlet so that the lighting fixtures are symmetrically located according to ceiling tile and room layout. When necessary, with the Engineer's approval, outlet shall be relocated to avoid interference with structural features of the building.

F. When conduit, insert or sleeves for outlet boxes and/or conduits are required, Contractor shall supply and install all conduits, inserts or sleeves and shall fully coordinate the installation thereof with other trades.

1.011 SUBMITTALS

A. Submittals shall meet the requirements of Section 01300.

B. All material shall be new and a standard product of a reputable manufacturer. Deliver to site in original factory cartons with full manufacturer's warranty. Each type of material or equipment shall be of the same manufacturer throughout the project.

C. The Contractor shall submit for approval shop drawings and cutsheets for each item and system. Furnish catalog data for all items of material, except where the information is included with shop drawings. Shop drawings shall show the ratings of items and systems and how the components of an item and system are assembled, function together, and how they would be installed on the project. Data and shop drawings for component parts of an item or system shall be coordinated and submitted as a unit.

1. Required for all electrical equipment and includes but is not limited to the following:

a. Qualification certificates
b. Contract Cost Breakdown

c. Panelboards, switchboards and breakers

d. Light fixtures, standards and appurtenances

e. Switches and receptacles

f. Motor control centers, motor starters, VFDs

g. Equipment controllers and switches

h. Disconnects and fusible switches

i. Special switches, pushbutton stations and controls

j. Those specific items called out elsewhere in the specifications which require special coordination and/or details

k. Electric heaters and thermostats

l. SCADA & Telemetry systems

m. Computer & networking equipment & PLC equipment

n. Fans and grilles

o. Raceways, wiring devices, floor boxes, wires and cables

p. Generators & Transfer switches

q. All instruments, sensors & equipment

r. Instrumentation, metering, flow, level, temperature, pressure, etc., sensing equipment

D. Single Submission. Data and shop drawings shall be supported and included in a single submission. Multiple submissions are not acceptable except where prior approval has been obtained from the Engineer. In such cases, a list of data to be submitted later shall be included with the first submission. Submit five (5) copies in one or more 3-ring binder notebooks, vinyl covered, with proper index and dividers.

E. Context. The lists of materials and equipment shall be supported by sufficient descriptive material, such as catalogs, cuts, diagrams and other data published by the manufacturer, to demonstrate conformance to the specification requirements; model numbers alone will not be acceptable. The contractor shall submit photometric performance curves for each lighting fixture to assure proper lighting distribution and quality at the design conditions. The data shall include the name and address of the nearest service organization. All cut sheets must be marked to show the actual model of each item used and all related appurtenances with proper model and part numbers.

F. Shop Drawings. Shop drawings shall include complete construction details, dimensions, material descriptions, diagrams or pictures showing physical characteristics, performance and test data, description of operation, installation methods, wiring diagrams and any other data or information necessary for a complete evaluation. (Note: do not re-draw the
contract drawings. The drawings to be submitted under this subsection are all the supplemental drawings and manufacturers' specification drawings which are not included in the contract drawings.) Shop drawings are in addition and supplemental to the contract drawings.

G. Identification. In addition to the requirements of Special Provisions, submittals shall be identified by the name of the system and applicable specification paragraph number.

H. Delivery Prior to Approval. No item of material or equipment shall be delivered to the site or installed, until approved. After the proposed materials have been approved, no substitution will be permitted except where approved by the Engineer.

I. Compliance. Should the Contractor fail to comply with the requirements of these provisions, the Engineer reserves the right to select any or all items of materials and systems. Selection shall be final and binding upon the Contractor. Materials so selected or approved shall be used in the work at no additional cost to the Owner.

J. Departures. If departures from the contract drawings are deemed necessary by the Contractor, details of such departures, including changes in related portions of the project and the reasons therefore, shall be submitted with the drawings. Where such departures require raceways or equipment to be supported otherwise than as shown, the details submitted shall include loadings and type and kind of frames, brackets, stanchions, or other supports necessary. Approved departures shall be made at no additional cost to the Owner.

K. Electrical Diagrams. A complete electrical connection diagram for each item of equipment furnished under Division 16, which has electrically controlled components having more than one automatic or manual control device, shall be submitted for approval. Wiring diagrams shall identify each component, and one diagram shall show all interconnected or interlocked components. It is understood that the contract electrical drawings do not have to be submitted or copied for inclusion in this submittal.

L. Contractor agrees that submittals processed by the Engineer are not change orders; that the purpose of submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and material he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.

M. Late submittals will not be considered an excuse for time extension for the project.

1.012 SUBMITTAL RECORD DRAWINGS/ASBUILTS/O & M MANUAL (AT PROJECT END)

A. Record Drawings. Corrections and changes made to the contract drawings during the progress of the work shall be recorded in a legible hand, in red pencil, continuously on a copied set of the contract drawings kept readily available at the project under construction. The purpose of these Record drawings is to provide the Engineer with an easy to read, complete record of the installation so that at the end of the project the Engineer can revise the original contract drawings to represent the actual installation. Color-coded and highlighted notes shall be used if these would make the Record Drawings easier to read. These drawings shall also include such information as all wiring labels, conduit sizes and labels, overload sizes and accurately locate all underground and under-slab piping and stub-outs. At the completion of the work, Contractor shall furnish the Engineer this set of drawings. Final payment to the Contractor will not be authorized until these drawings have been submitted to and accepted by the Engineer.
B. Supplemental As-Built Electrical Drawings. As-Built Drawings supplementary to and not already included in the contract drawings shall be assembled and delivered to the Engineer in the form of five (5) bound copies. The Electrical Engineer will revise the original bid drawings by information supplied by the Contractor on the Record Drawings but any other electrical equipment or connections not shown on the bid drawings or Record Drawings shall be documented by supplementary as-built drawings supplied by the Contractor.

C. The Contractor shall prepare and deliver five (5) copies of an Electrical Equipment Maintenance Manual for all electrical equipment installed on the project. This manual shall coordinate with and be an integral part of the plant O&M manual set and plant drawings. This manual, along with the plant electrical drawings and the Software Integrator's process control manual shall compose the electrical section of the plant O&M manual set. The Electrical Engineer will provide updated plant electrical drawings at the end of the project which have been revised by the Contractor's Record Drawings. The Contractor shall be responsible for providing all other drawings. The purpose of this manual is to provide one comprehensive document which illustrates and describes all the electrical equipment and instrumentation installed in the plant. The manual shall include but not be limited to drawings and specifications for the following items as applicable to this project:

1. Motor Control Centers and all related controls, protection and appurtenances.
2. All electronic controls and all appurtenances.
3. Instrumentation devices and telemetry equipment.
4. Heating/Ventilating/Lighting equipment furnished under this Division.
5. Thermostats.
6. Electrical panel schedules and modifications to existing electrical equipment.
7. Solenoid valves.
8. Disconnects.
9. Level Controllers/Float Controls.
10. Motor starters, variable frequency drives, reduced voltage starters and similar equipment.
11. Programmable Logic Controls (PLCs) and any other computer devices and their related peripheral equipment.
12. Commented and annotated software listings of any software or programs developed under this Division uniquely for this installation.
13. Commented and annotated documentation of any programmed set points or programmable setup parameters for any programmable equipment (for example, chart recorders, VFDs, instrumentation, telephone dialers, etc.).
14. All electrical control panels supplied by equipment manufacturers.
15. All other electrical equipment or instrumentation, whether provided by the Electrical Contractor or not.

D. The manual shall be assembled in one or more white 3-ring binder notebooks with "D" style rings, each vinyl covered with a clear vinyl pouch on the outside spine and front to receive a cover title. Contractor shall insert printed spine and cover title sheets to match font style and size of the rest of the plant O&M manual set. Coordinate with the General Contractor.

E. The information contained in the manual shall be grouped in an orderly arrangement by category. It shall have a typewritten index and divider sheets between categories with identifying tabs.

F. The information included must be the exact equipment installed, not the complete "line" of the manufacturer. Where sheets show the equipment installed and other equipment, the installed equipment shall be neatly and clearly identified on such sheets. Parts lists shall give full ordering information assigned by the original parts manufacturer. Relabeled and/or renumbered parts information as reassigned by the equipment supplier are not acceptable.

G. It shall contain all information presented in the post bid equipment submittal in addition to: shop drawings, equipment wiring diagrams, operating and maintenance instructions, individual equipment operating and installation manuals, replacement parts lists, and equipment nameplate data for all equipment and systems installed under the project. Electrical and/or electronic equipment data shall contain step-by-step circuit description information and printed wiring diagrams designed to provide electronic service technicians with adequate information to diagnose and repair the components on each circuit board. Electrical and/or electronic equipment submittals shall contain step-by-step signal and control description information designed to provide maintenance personnel with an understanding of equipment operation in each mode of operation. Unit Control and Motor Control Center manuals shall be included with a complete functional description of operation in narrative form for each control center function.

H. Diagrams for each system shall be complete drawings for the specific system installed under the contract. "Typical" line diagrams will not be acceptable unless properly marked to indicate the exact field installation.

I. Manuals and documentation shall include calibration curves of every sensing device and a programming documentation sheet for every programmable device. The programming documentation sheet shall show the final operational value of every programmable parameter of every device. The purpose of this sheet is to provide maintenance personnel with a convenient source of information for programming the parameters of a replacement device should the old device fail.

J. Include all electrical devices provided under all Divisions. Coordinate with other Division Contractors.

1.013 INSTRUCTION OF OWNER EMPLOYEES

A. Instruction of all electrical equipment shall be provided to insure proper use and care as well as firsthand operation of electrical equipment and components.

B. Electrical Contractor shall provide one 8-hour working day of instruction to Owner designated personnel.
C. The time for this instruction shall be scheduled shortly after start-up and at mutually agreed times. Contact Engineer for coordination.

1.014 TESTING

A. Test the entire electrical installation to assure compliance with code and proper system operation.

1. Circuit Tests. The Contractor shall test all wiring and connections for continuity and ground before any fixtures or other loads are connected. Tests shall be made with a 500 volt DC “Megger” type tester. If tests indicate faulty insulation (less than 2 megohms) such defects shall be corrected and tested again. Contractor shall provide all apparatus and material required to make tests and shall bear all expense of required testing.

2. Load Balancing. Checks shall be made for proper load balance between phase conductors and make adjustments as necessary to bring unbalanced phases to within 15% of average load.

3. Ground Testing. Measure the OHMIC value of the Electric Service Entrance metallic “System Ground” with references to “Earth Ground” using the “Multiple Ground Rod” method and suitable instruments. Maximum resistance to ground shall be less than 10 ohms. If this resistance cannot be obtained with the ground system shown, notify the Engineer immediately for further instruction. Certify in writing to the Engineer that the grounding test has been made and that the requirements of this portion have been met for the “System Ground”.


B. Materials and instrumentation shall be provided by the Contractor.

C. The Contractor shall notify the Engineer ten (10) working days prior to performance of any test.

D. The Contractor shall certify in writing that the above tests have been completed and shall provide documentation of test data.

1.015 DEMONSTRATION OF COMPLETED ELECTRICAL SYSTEMS AND CONTROLS

A. At the point of substantial completion of the project, the Electrical Contractor shall provide necessary personnel to demonstrate the essential features of the following electrical systems:

1. Service entrance equipment.

2. (Via the Integrator) Motor Control Center and all related items such as controls, alarms, software, PLC and PC equipment, etc.

3. Lighting system.

4. Heating system.

5. Ventilation.
6. Pumps, compressor, blowers, mixers, and related controls and alarm.

7. Instrumentation

B. Demonstrate each system once after all malfunctions have been corrected.

C. Time. Demonstration shall be held upon completion of all systems at a date agreed upon in writing by the Owner or his representative. This time shall be in addition to the instruction allowances provided.

D. Attending Parties. The demonstration shall be held by the Contractor and Electrical Subcontractor in the presence of the Owner or his designated representative, Electrical Engineer, Project Engineer, and the Equipment Manufacturer's representative.

E. Demonstration.

1. Demonstrate by "start-stop operation" and "automatic operation", how to work the controls, how to reset protective devices or replace fuses, and what to do in case of emergency.

2. All systems shall be exercised through operational tests in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of work specified elsewhere in these Contract Documents. The scheduling of tests shall be coordinated by the Contractor among all parties involved so that the tests may proceed without delays or disruption by uncompleted work.

1.016 WARRANTY

A. Warranty materials and workmanship for a period of one year from date of final acceptance for the project or through one entire system operating season if this exceeds year date.

B. Provide written warranty for one year. Submit two written copies with Operation and Maintenance Manual.

C. Warrantee includes all material and labor to repair or replace defective items within any system, and extends to material and labor required to repair adjacent surfaces disturbed by malfunction.

D. Equipment, programming, and materials which do not achieve design requirements after installation shall be replaced or modified by the Contractor to attain compliance at no additional cost to the Owner. Following replacement or modification the Contractor shall retest the system and perform any additional procedures needed to place the complete system in satisfactory operation and attain design compliance approval from the Engineer.

E. All panel lamps shall be guaranteed for 90 days. Guarantee will become effective only after substantial completion of the project.

1.017 ABBREVIATIONS

A. The following is a list of abbreviations and terms most commonly used in the electrical industry.
B. Reference is made to current editions and publications of the following technical societies, organizations or bodies:

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<td>ANSI</td>
<td>American National Standards Institute</td>
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<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
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<tr>
<td>CBM</td>
<td>Certified Ballast Manufacturers</td>
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<tr>
<td>ETL</td>
<td>Electrical Testing Laboratories</td>
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<tr>
<td>NBFU</td>
<td>National Board of Fire Underwriters</td>
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<tr>
<td>NECA</td>
<td>National Electrical Contractor’s Association</td>
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<td>National Fire Protective Association</td>
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<td>UL</td>
<td>Underwriter’s Laboratories, Inc.</td>
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<td>MFR</td>
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</table>

C. Definitions.

1. “Furnish” Deliver to the job site
2. "Install" To enter permanently into the project
3. "Provide" Furnish and install
4. "Contractor" The company responsible for accomplishing Division 16 work.

1.018 BASIC ELECTRICAL SYMBOLS

A. See drawings legend.

PART 2 PRODUCTS

2.01 GENERAL

A. General requirements for materials.

2.02 PRODUCTS

A. All materials must be of the quality herein specified. All materials shall be new, of the best quality and free from defects. They shall be designed to insure satisfactory operation and operating life in the environmental conditions which will prevail where they are being installed.

B. Each type of material shall be of the same make and quality. The materials furnished shall be of the standard products of manufacturer's regularly engages in the production of such equipment.

C. Fixtures and equipment shall be current models for which replacement items or component parts are readily available. Unless otherwise provided, all electrical items used shall be substantially the same as items of manufacturer which, on the date of opening bids, have been in successful commercial use and operation for not less than one year in projects and units of comparable size. The right is reserved by the Engineer to require the Contractor to submit a list of buildings where they have been in operation, so that such investigation as may be deemed necessary may be made before approval.

D. Capacities of all equipment and material shall be not less than those indicated.

1. Accuracy. Unless otherwise specified, each individual instrument shall have a minimum accuracy of +0.5 percent of full scale and a minimum repeatability of +0.25 percent of full scale.

2. Field Tests: The Contractor shall perform whatever tests as may be requested by the Engineer or as may be needed otherwise to demonstrate compliance with the Contract Documents.

3. Calibration. The Contractor shall provide job site visits and services of a manufacturer's technical field representative for calibration, testing and startup of instrumentation and equipment as needed. All instruments and systems shall be calibrated after installation, in conformance with the component manufacturer's instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation, and that the components and/or systems are within the specified limits of accuracy. Defective elements, which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. This calibration work shall be accomplished by the technical field representatives of the System
Supplier whom the Contractor shall require to certify in writing that for each loop or system all calibrations have been made and that all instruments are ready to operate.

4. Proof of Conformance: The burden of proof of conformance to specified accuracy and performance is on the Contractor using its designated System Supplier. The Contractor shall supply necessary test equipment and technical personnel if called upon to prove accuracy and/or performance, at no separate additional cost to the Owner, wherever reasonable doubt or evidence of malfunction or poor performance may appear.

E. Nameplates. Each major item of equipment shall have the manufacturer's name, address, serial and model numbers on a plate securely attached to the item.

F. Conformance of agency requirements. Where materials or equipment are specified to be constructed and/or tested in accordance with the standards of the following agencies or organizations, the Contractor shall submit proof of such compliance:

1. The Institute of Electrical and Electronics Engineers (IEEE).
2. The National Electrical Manufacturer's Association (NEMA).
3. The Underwriter's Laboratories, Inc. (UL).

G. All meters, instruments, and other components shall be the most recent field proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise specified to match existing equipment.

H. Analog measurements and control signals shall be electrical as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted. Electrical signals outside control panel(s) shall be 4 to 20 milliamperes dc except as noted.

I. Environmental. All instrumentation shall be suitable for operation if required, in the ambient conditions at the equipment installation locations. Heating, cooling, and dehumidifying devices shall be incorporated with the outdoor instrumentation in order to maintain it within its rated environmental operating ranges. The Contractor shall furnish and install all power wiring for these devices (e.g., heaters, fans, etc.). NEMA 4 rated enclosures shall be furnished in all general purpose areas, unless otherwise specified. Equipment and systems shall be designed and constructed for satisfactory operation and long, low maintenance service under the following environmental conditions:

1. Control Room: Temperature range: 32 degF through 120 degF. Thermal shock: 1.0% (1.8%F) per minute maximum. Relative humidity: 100 percent maximum
2. Remote Site: Temperature range: 0 degF through 135 degF. Thermal shock: 1.0% (1.8%F) per minute maximum. Relative humidity: 100 percent maximum

J. Protection. Materials and equipment delivered to the site shall be stored and protected in such a manner as to effectively prevent damage from climatic conditions, condensation, dust, physical abuse. A location shall be chosen which will not interfere with the operations of other contractors or the Owner. Storage and handling shall be performed in manners which will afford maximum protection to the equipment and materials. It is the Contractor's responsibility to assure proper handling and on-site storage of instrumentation and control equipment in accordance with the manufacturers'
2.03 COMPLETED SYSTEMS

A. All the systems mentioned shall be complete in every detail except where specifically noted otherwise. Mention of certain materials in these specifications shall not be construed as releasing the Contractor from furnishing such additional materials and performing all labor required to provide a complete and operable system.

2.04 NAMEPLATE AND EQUIPMENT LABELS

A. Provide nameplates constructed of plastic laminated material engraved through black surface material to white sub-layer. Exception: Emergency distribution system component labeling - white letters on red background.

B. Service Entrance Label. Refer to appropriate section.

C. Panelboard Labels. Refer to appropriate section.

D. Receptacle Labels. Refer to appropriate section.

E. Motor Starter and Disconnect Labels. Refer to appropriate sections.

F. Special Equipment Outlet Labels. Refer to appropriate sections.

PART 3 EXECUTION

3.01 INSTALLATION AND WORKMANSHIP

A. Materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer to conform with the contract documents.

B. The installation shall be accomplished by workmen skilled in this type of work.

3.02 CUTTING OF BUILDING CONSTRUCTION

A. Obtain permission from the Engineer prior to cutting. Locate cuttings so they will not weaken structural components. Cut carefully and only the minimum amount necessary. Cut concrete with diamond core drills except where space limitations prevent the use of such drills.

B. All construction materials damaged or cut into during the installation of this work must be repaired or replaced with materials of like kind and quality as original materials by skilled labor experienced in that particular building trade.

3.03 EXCAVATION AND BACKFILLING

A. Provide all necessary excavation and backfilling for installation of underground electrical facilities. Depth per code requirements or as shown.

B. Determine location of all existing underground gas, water, sewer, telephone and electric lines. Locate accurately on ground surface and for depth of same before excavation. Uncover by hand digging. Contractor shall be responsible for any damage or interruptions to these utilities, caused by himself, and other costs incurred by these interruptions.
C. Do not undermine footings or bearing walls.

D. Use power digging equipment only in direction away from existing facilities.

E. Exercise standard safety precautions in excavation near power cables by using insulated handles, rubber gloves and footwear, etc.

F. Do not place backfill until installation to be covered has been tested, inspected and approved.

G. Backfill beneath building slabs, areas to be paved, streets, or sidewalks: 3/4" maximum crushed rock, gravel or sand. Other areas may be backfilled with excavated earth that has all large rocks and foreign matter removed.

H. Backfill in layers not to exceed 6 inches. Compact thoroughly.

I. Dispose of all debris and surplus earth as directed by the Owner.

3.04 PAINTING

A. Painting in general will be covered under another Division 9 of these specifications, except items furnished under this Division that are scratched or marred in shipment or installation and/or require custom painting.

B. Install equipment with manufacturer's standard finish and color unless otherwise specified. Refinish any marred or oxidized items restored to manufacturer's factory finish.

C. Required surfaces or equipment with no standard finish; clean off grease and scale. Restore to smooth finish. Give one coat of primer, two coats finish.

D. Paint and color as selected by Engineer.

E. All exposed conduits on painted walls shall be painted to match wall and trim colors. Painting to be in accordance with Item (b.) above. Conduit labels shall be neatly affixed and shall not be painted over.

3.05 CLEANUP

A. Contractor shall continually remove debris, cuttings, crates, cartons, etc., created by his work. Such clean up shall be done at sufficient frequency to eliminate hazard to the public, other workmen, the building or the Owner's employees. Before acceptance of the installation, Contractor shall carefully clean cabinets, panels, wiring devices, cover plates, light fixtures, etc., to remove dirt, cuttings, paint, plaster, mortar, concrete, etc. Blemishes to finished surfaces of apparatus shall be removed and new finish equal to the original applied.

3.06 WORKMANSHIP AND INSPECTION

A. Workmanship shall be of the best quality and none but competent electricians shall be employed. All shall be under the supervision of a competent foreman. All completed work shall represent a neat and professional appearance.

B. All work and materials shall be subject to inspection at any and all times by representatives of the Engineer.
PART 4      SPECIAL PROVISIONS

4.01  MEASUREMENT AND PAYMENT

A. Payment for electrical material and methods, and other work in this section shall be included within the applicable unit price or lump sum items in the Bid Form, and shall include, but not be limited to, compensation for all labor, material, and equipment required for the construction/installation of the work described herein. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 16060 – GROUNDING SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION OF WORK

A. Work consists of providing the complete grounding system shown on the drawings and specified herein. The requirements of all other sections of the specification are equally applicable to the work to be performed under this section.

1.02 GROUNDING SYSTEM

A. This grounding specification is applicable to this and all other sections of the work. Provide all grounding systems and make connections mechanically secure and electrically continuous. Ground all line voltage electrical systems completely and effectively as required by code and as specified herein.

B. Ground all raceway systems and equipment enclosures. Where not otherwise indicated, grounding conductor size shall conform to the most stringent of the governing codes.

1. Ground the service and transformers in an approved manner.

2. Provide grounding where indicated on the drawings.

3. Grounding conductor connections shall be bolted except at inaccessible ground rods, buried ground conductors and reinforcing steel grounding conductor connections, where connections shall be brazed or crimped.

4. Exothermic welded connections may be substituted for brazed connections subject to the Engineer’s approval and demonstration on the project with actual test connections that the connections will be successfully made.

5. Ground conductors, unless otherwise noted, shall be insulated and shall be run in conduit. In no case shall the grounding conductors be sized smaller than #12 AWG.

6. Continuity of equipment ground shall be maintained throughout the entire raceway, cabinet and equipment enclosure system. Ground bushings and jumpers shall be used wherever normal conduit termination does not insure continuity. Where nonmetallic conduit is used for distribution or where direct burial cables are employed, install a green insulated equipment ground conductor with each circuit.

7. Metal parts of lighting fixtures not otherwise grounded by bolted fastenings shall be bonded to conduit system with green ground wire. Receptacles shall be grounded to outlet boxes with green ground wire and machine screw.

8. Motors and equipment shall be bonded to the equipment grounding system by a continuous green insulated equipment ground conductor run with each circuit through approved flexible conduit connections as permitted by code. Where flexible conduit size exceeds the code approved limits, provide a separate green grounding conductor inside each flexible conduit, bonded to the inside of the connection box and to the nearest accessible supply end conduit junction box.

9. Where concrete pad is provided for utility-furnished transformers, suitable grounding systems shall be provided under this section, including driven ground...
rods. Details on the drawings are to establish the general scope of work, but installation shall conform to the serving utility company requirements.

C. Provide ground system as specified here and shown on Drawings.

**PART 2 PRODUCTS**

2.01 GROUNDING BUSHINGS/WEDGES

A. On all feeders, install a grounding bushing with set screw connector.

2.02 CONNECTORS

A. Cast, set screw or bolted type.

2.03 GROUND RODS

A. Minimum one uncoated 0.50” #4 reinforcing bar tied into foundation reinforcing grid, per the 2017 Oregon Electrical Specialty code.

B. Two 5/8” copper clad 10’ ground rods at each building, or as shown in Contract Drawings.

2.04 CONNECTONS

A. Ground rod to ground conductor connections, exothermic weld process. Cadweld.

**PART 3 EXECUTION**

3.01 INSTALLATION

A. Grounding conductor connectors shall be made up tight and located for future servicing and to insure low impedance.

B. The Grounding System shall comply with Article 250 of the N.E.C.

C. All feeder and service raceways shall be grounded.

D. All plug-in receptacles shall have the grounding stud connected to the insulated green equipment grounding conductor shown in all power system conduits.

E. Connect all insulated green ground conductors on a grounding bus in the respective branch circuit panel. Provide a grounding bus in all existing panels which presently are not so equipped.

**PART 4 SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Payment for the grounding system and other work in this section shall be included as a portion of the lump sum for the Electrical, Wiring, Panels and Level Control as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 16120 – WIRE AND CABLE

PART 1  GENERAL

1.01  INTRODUCTION

A. All wire and cable for electric circuits shall conform to the latest requirements for the current edition of the NEC and shall meet all ASTM specifications.

B. Any requirements in this section shall be additional.

C. Provide all wire and cable complete.

D. Provide all wire appurtenances.

E. Size as shown on drawings and/or in panel schedule or as required, if not shown otherwise.

F. All wire and cable to be copper.

G. No aluminum conductors are allowed except Electric Utility provided wire or unless specifically called out.

H. Wiring size is generally standard AWG size. Branch circuit cross hatchings shown indicates minimum number of wires, without ground. Minimum size or as noted on plans, or panel schedules.

PART 2  PRODUCTS

2.01  WIRE

A. Conductors shall be soft-drawn copper with insulation and outer covering as noted. Conductor sizes shall be standard American wire gauge sizes. Conductors No. 8 and larger shall be stranded. All control wiring below 12 gauge shall be stranded.

B. Minimum branch wiring shall be No. 12, 600 volt and shall have color coded phase wires.

C. #16 and lower AWG shall be type TFF or THHN 600 volt stranded.

D. #14 through #10 AWG shall be type THW, THWN, or THHN 600 volt stranded conductor.

E. #8 AWG and larger shall be type THHN or 600 volt stranded conductor.

F. Conductors installed in underground conduits shall be THW, THWN or THHN as described above.

G. Direct buried feeder and branch circuit cable shall be Type UF or USE as per NEC Article 338 and 339. Buried conductors shall normally be in PVC conduit. Direct buried conductors shall only be permitted upon prior approval by the Engineer.

H. Contractor provided conductors between Utility Power source and meter base shall be stranded aluminum THHN, THWN, or THHN-2 as provided by utility.

I. Conductors installed in the wiring channels or in ballast compartments of continuous row fixtures, and in raceway between junction box and recessed fixture to be RHH, 90 deg. C
(194 Deg. F) insulation. Do not reduce branch circuit conductor size below circuit protection in wiring channels. Other fixture wiring shall be Type “AF” or “SFF”.

J. Wire size, insulation and manufacturer’s name shall be clearly and permanently marked on conductor jacket.

K. Wire Color.
   1. Wires shall be factory color-coded by integral pigmentation. Colored plastic tape permitted on #6 and larger where integral pigmentation impractical. Apply tape in spiral half-lap over exposed portions in manholes, boxes, panels, switchboards, and other enclosures.
   2. Identify second system voltage conductors with different set of colors at all panels, disconnects, junction boxes and/or equipment with 3ø power supply.

<table>
<thead>
<tr>
<th>Conductor System Voltage</th>
<th>120/240</th>
<th>277/480</th>
<th>120/208</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase A</td>
<td>Black</td>
<td>Brown</td>
<td>Black</td>
</tr>
<tr>
<td>Phase B</td>
<td>Red</td>
<td>Orange</td>
<td>Red</td>
</tr>
<tr>
<td>Phase C</td>
<td>Blue</td>
<td>Yellow</td>
<td>Blue</td>
</tr>
<tr>
<td>Neutral</td>
<td>White</td>
<td>Grey</td>
<td>White</td>
</tr>
<tr>
<td>Equip Gnd</td>
<td>Green or bare</td>
<td>Green or bare</td>
<td>Green or bare</td>
</tr>
<tr>
<td>Travelers</td>
<td>Grey or tan</td>
<td>Grey or tan</td>
<td>Grey or tan</td>
</tr>
</tbody>
</table>

2.02 CABLE
   A. Annealed copper in AWG and type as shown on drawings.
   B. All conductors shall have color coded pairs.
   C. Labels. All cables shall be labeled with a wire marker. The label shall be of the form "CBLXXX" where XXX is a unique number (for example: CBL132, CBL001, CBL567). The markers shall be permanently marked heat-shrink plastic, such as Kroy "Shrink Tube," or equivalent. All markers shall be shrunk to fit the cable with a manufacturer’s approved heat shrinking device.

2.03 PULLING LUBRICANTS
   A. UL approved soap type only.

2.04 WIRE MARKERS
   A. Pre-marked, heatshrink type. All wires shall be marked. Each conductor shall be designated by a single unique wire number which shall be shown on all drawings. These numbers shall be displayed on all conductors at every terminal or termination using preprinted white wire markers with black numbers. The markers shall be permanently marked heat-shrink plastic, such as Kroy "Shrink Tube," or equivalent. All markers shall be shrunk to fit the wire with a manufacturer’s approved heat shrinking device.

2.05 PULL WIRES
   A. Dry Location. #16 galvanized iron.
B. Damp Locations, Under Slab, or Below Grade. #12 TW Copper or polypropylene pull rope.

2.06 WIRE CONNECTION AND APPURtenances

A. Wire connections shall be made with pressure-type solderless connectors.

B. Connections Between Aluminum and Copper. No aluminum is allowed.

C. Oxide Inhibiting Compound. Alnox "UG", Idean "NOALOX", Penetrox "A".

D. Inline Splicing Kits. 3M brand "Quick Splice", 5400 series.

E. Waterproof Splicing. 3M Scotchcast.

PART 3 EXECUTION AND WORKMANSHIP

3.01 DELIVERY, STORAGE AND HANDLING

A. Deliver to site in new standard coils or reels with approved tag denoting length, wire size, insulation type and manufacturer's name.

B. Suitably protect from dirt, weather, and damage during storage and handling.

3.02 WIRE PULLING

A. Do not pull wire until all work of any nature is completed which might damage insulation or fill conduit with foreign material. Conduits shall be clean and dry before pulling wire.

B. Do not use mechanical means to pull #8 or smaller wires.

C. Exercise care in avoiding injury to wire or insulation during pulling.

D. Identify all wires or circuits with wire markers after pulling. For all control wiring and telemetering systems, wire markers in junction boxes and at solenoids shall bear same numbers as terminal blocks. Keep accurate up-to-date as-built records.

3.03 CIRCUITING

A. Conduit may be routed at Contractor's best judgment unless directed otherwise. Home runs are diagrammatic for clarity, and may be grouped as desired. Size conduits accordingly with capacity for 25% fill. See Raceways this Division. All branch circuitry conduit shall have NEC sized ground provided.

B. Any deviation in circuiting that is approved by the Engineer shall be recorded on as-builts and panel schedules in specifications.

3.04 SPlicing

A. No splices or taps permitted in service or feeder circuits. Splices or taps in branch circuits permitted only in junction boxes where circuits divide.

B. Splices to fixtures and equipment shall have a 6-inch minimum pigtail.

3.05 PULL WIRES
A. Provide pull wires in all empty conduits for future use. Identify both ends with labels or tags reading "PULL WIRE" with a number for reference.

3.06 WIRE CONNECTION AND SPLICING

A. Manufacturer's Instructions. Install connectors in strict accordance with manufacturer's instructions for specific conductor size, voltage and type of connection required.

B. Insulation. Cover splices, joints and free ends of conductors with insulation equivalent to that of conductor, using insulating rubber tape and friction tape or plastic tape.

C. Continuity. Where conductors are connected to metallic surfaces, remove any coating and polish surface. Remove lacquer coating of conduits where ground clamps are to be installed.

D. Waterproof Splices. Waterproof splices and connections to fixtures and equipment as designated on drawings shall be Scotchcast, 3M or approved. Leave 18" pigtail for future splices.

E. It is the responsibility of the electrical contractor to utilize proper protective tape as deemed by the equipment or motor and equipment temperature conditions, for a quality craftsmanship type job.

F. No splices are allowed in control cables, telemetering or telephone cables above or below the ground unless in a junction box or control panel without permission from the Engineer.

3.07 ENCLOSURE SIGNAL AND CONTROL CIRCUIT WIRING

A. Wiring installation: All wires shall be run in plastic wireways except (1) field wiring, (2) wiring run between mating blocks in adjacent sections, (3) wiring run from components on a swing-out panel to components on a part of the fixed structure, and (4) wiring run to panel-mounted components. Wiring run from components on a swing-out or front panel to other components on a fixed panel shall be made up in tied bundles. These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals. Signal and low voltage wiring shall be run separately from power and 120 V control wiring.

B. Wiring run to control devices on the front panels shall be tied together at short intervals with nylon wire ties and secured to the inside face of the panel using adhesive mounts.

C. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.

D. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the Engineer's review.

E. Wire Marking: Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be permanently marked heat-shrink plastic as described above.

3.08 ELECTRICAL TESTS
A. Electrical insulation resistance tests for each of the following items shall be performed with respect to ground and adjacent cables.

1. All new switchboards, control wiring circuits, motor wiring circuits, panel boards and sub-distribution feeders from switchboards to panel boards.

2. Perform continuity test to insure proper connection.

3. Insulation resistance tests shall be performed at 1,000 volts D.C. for one-half minute.

<table>
<thead>
<tr>
<th>Conductor of Circuit Size</th>
<th>Minimum Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 14 and 12 AWG</td>
<td>1,000,000 ohms</td>
</tr>
<tr>
<td>25 - 50 ampere</td>
<td>250,000 ohms</td>
</tr>
<tr>
<td>51 - 100 ampere</td>
<td>100,000 ohms</td>
</tr>
<tr>
<td>101 - 200 ampere</td>
<td>50,000 ohms</td>
</tr>
<tr>
<td>210 - 400 ampere</td>
<td>25,000 ohms</td>
</tr>
<tr>
<td>401 - 800 ampere</td>
<td>12,000 ohms</td>
</tr>
<tr>
<td>Over 800 ampere</td>
<td>5,000 ohms</td>
</tr>
</tbody>
</table>

4. Insulation resistance shall in no case be less than following table.

5. These values are determined with all switchboards, panelboards, fuse holder, switches and overcurrent devices in place.

6. Test results shall be documented in an organized typewritten manner documented as "Insulation Resistance Test Report" and submitted to the Engineer in triplicate prior to acceptance.

7. Tests shall be done in the presence of the Engineer or his representative. Seventy-two (72) hour notice shall be given prior to testing.

8. Any circuit not meeting test requirements shall be replaced and retested until it meets test requirements.

**PART 4  SPECIAL PROVISIONS**

**4.01 MEASUREMENT AND PAYMENT**

A. Payment for the wire and cable and other work in this section shall be included as a portion of the lump sum for the Electrical, Wiring, Panels and Level Control as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

**END OF SECTION**
SECTION 16130 – RACEWAY AND BOXES

PART 1  GENERAL

1.01  WORK INCLUDED

A.  Provide raceway system complete. All sizes shown on the diagrams shall be considered minimums. All sizes and lengths provided in the conduit or wiring schedules shall be considered minimums and estimates. Contractor shall be responsible for selecting sizes that will properly accommodate all wires and cables. Contractor should assume that not all conduits are shown on the diagrams or in the schedules.

B.  All project wiring, including cables, shall be in conduit unless otherwise noted herein or on drawings.

C.  Sizes as shown on drawings or as required, if not shown on drawings. Conduit shall be filled no more than 25%. Provide pull wires in all empty conduits for future use. Identify both ends with labels or tags reading “PULL WIRE” with a number for reference.

D.  Chases, openings, sleeves, hangers, anchors, recesses, equipment, pads of framing for fixtures provided under other divisions only if specified or shown. Otherwise, provided under this Division. In any event, this Division shall be responsible for correct size and location.

E.  Codes and Standards. NEC shall govern use and installation of conduit types. Standards for conduits shall be as defined by ANSI, Federal and UL specifications. Standards for nonmetallic per NEMA TC-2. Any requirements of this section shall be additional.

F.  Labels. Any raceway which is not wholly contained in one room and whose full length is not clearly visible shall be labeled at each end, junction, size change, or any other place where a label would clarify its identity. The label shall be of the form “CXXX” where XXX is a unique number (for example: C132, C081, C567). A unique number shall be used for each raceway and shall be displayed and noted on the Record Drawings. The labeling means shall be a machine printed nylon wrap-around wire-tie style tag made for the purpose of labeling pipe or conduit. Other means of labeling may be submitted to the Engineer for approval. Hand-written indelible ink labels are not acceptable.

G.  The electrical contractor shall furnish and install all plant raceways, including instrumentation and signal raceways. Contractor is responsible for furnishing and installing all circuits and raceways necessary for a complete, working system, whether or not they are shown or described in the contract documents. The Division 16 Electrical plans do not show all conduits and those that are shown are shown schematically (not necessarily in their correct, installed, positions). Contractor should verify all conduits’ location and size by actual manufacturers’ data. Contractor shall coordinate with other division contractors to make sure that raceways shall be installed in the proper places and shall be the proper sizes and materials. Electrical Contractor shall also connect all power conductors to 120V/240V/480V plant devices, including instrumentation meters and recording devices furnished under other divisions. Electrical Contractor shall connect all analog 4-20mA current loop signal circuits.

H.  Consult the contract drawings for additional information, including the use of stainless steel raceway in many locations. Special study should be given to the manufacturers'
equipment plans to assure that appropriate conduits and conductors are installed so that all components are properly connected.

**PART 2 PRODUCTS**

2.01 RIGID GALVANIZED STEEL CONDUIT (RGS)

A. Required in all concrete or block work unless otherwise specified. Required for all stub-ups. Required for all transitions from underground PVC when passing through concrete. Required in all outdoor areas or wet locations.

B. Constructed to CSA C22.2 No. 45 rigid zinc coated steel.

C. Must have additional corrosion resistance provided by one of the following:
   1. PVC exterior coating with a minimum of 40 mils of PVC and minimum interior coating of 2 mils of urethane. Shall be Rob Roy or Ocal.
   2. Epoxy coating to a minimum of 4 mils on the exterior and a minimum 2 mils of coating of epoxy or Teflon on the interior. Example: Thomas and Betts Bluekote.
   3. Polymer coating system over Zinc coating, such as Gafco Green with associated boxes, elbows and terminations.
   4. Rigid Stainless Steel (SS) Conduit may be substituted.

D. Rigid fittings to be galvanized malleable iron or noncorrosive alloy compatible with galvanized conduit. Rigid fittings shall have the same coating system as the conduit bodies and used to manufacturer’s specifications. Erickson couplings, watertight split couplings (OZ or equivalent) permitted.

2.02 ELECTRICAL METALLIC TUBING (EMT)

A. Hot dip galvanized, electrogalvanized or sherardized, steel tubing. Permitted only in conditioned indoor locations or where specified.

B. Couplings and Connectors. Raintight; steel or malleable iron type using a split corrugated compression ring and tightening nut or stainless steel locking disc. Indenter or set screw fittings shall only be acceptable in office and laboratory rooms.

2.03 PVC CONDUIT

A. Schedule 40 rigid polyvinyl chloride type with ground wire. Generally required for all underground installations. Not permitted in any concrete or block work. Not permitted for stub-ups, even in protected areas (except power pole risers). Not permitted in attics.

B. Pre-formed PVC elbows and fittings unless otherwise noted on drawings.

2.04 RIGID ALUMINUM CONDUIT

A. Permitted only in specified areas.

B. Fittings to be copper free cast aluminum.

2.05 FLEXIBLE CONDUIT, DRY LOCATION.
A. Galvanized flexible steel. Permitted only in specified areas. Generally, use PVC coated flex for all flex locations.

B. Fittings galvanized malleable iron or steel, Thomas and Betts "squeeze" type or approved.

2.06 FLEXIBLE PVC CONDUIT, WET LOCATIONS
A. Liquid Tight, PVC weatherproof for damp and wet locations.
B. Fittings Thomas and Betts or approved.

2.07 SURFACE METAL RACEWAY
A. Formed steel type, standard factory painted finish. Where choice of colors is available, consult Engineer for color selection.
B. All hinged type raceways to have piano type hinges.
C. Surface metal raceways only allowed where specifically called out on drawings, or unless prior approval by Engineer.

2.08 RIGID STAINLESS STEEL CONDUIT (SS)
A. Solid stainless steel. Required in most outdoor environments or as specified.
B. Fittings to be threaded stainless steel. Stainless steel Erickson couplings, watertight split couplings (OZ or equivalent) permitted so long as all components are of the same stainless steel alloy and are water proof.

PART 3 EXECUTION

3.01 CONCEALED WORK
A. In general, install raceways concealed in construction except where shown otherwise on the Drawings or unless specifically approved by Engineer.

3.02 CLEAN & DRY
A. Install conduit dry and free of debris using approved plugs or caps. Cap and securely support conduits prior to concrete pour.

3.03 ROUTING
A. Conduit in general may be routed at Contractor’s best judgment unless directed otherwise. All conduits in or under concrete floors shall be recorded on as-builds as distances from walls in feet or inches. Home runs are diagrammatic for clarity and may be grouped as desired.

3.04 RIGID GALVANIZED STEEL CONDUIT (RGS)
A. All connections shall be watertight. Install RGS for all raceways in concrete or where subject to damage. Running thread or set screw type fittings not approved.
B. Conduit in Slab.
1. Minimum 3" concrete cover. Space not less than 8" on center and as wide as possible where converging at panel, etc.

2. Do not interfere with placement of reinforcing steel. Place conduit between upper and lower layers.

C. Expansion Joints. Install offset or sliding type where embedded conduits cross building expansion joints. Sliding type to have bonding strap and clamp.

D. Floor Stub-Ups - Accessible Floor Areas. Install rigid conduit with threaded coupling set flush with finished floor. Seal with flush, threaded pipe plug.

E. Raceways that stub-up above floor: Install at such depth that the exposed raceway is vertical and no curved section of the elbow is visible.

3.05 RIGID STAINLESS STEEL CONDUIT (RGS)

A. Install using the same methods as RGS conduit.

B. SS conduit is only necessary where used as an additional corrosion protection or where noted specifically on drawings.

3.06 RIGID ALUMINUM CONDUIT

A. Do not install aluminum conduit in earth, cinders or concrete.

B. May be used in lieu of steel where conduit is run in attics or above suspended ceilings where not subject to physical damage.

C. Not allowed where attached to concrete or masonry. Not allowed where other adjacent metals might electrolytically react with the aluminum.

3.07 ELECTRICAL METALLIC TUBING (EMT)

A. Install for wiring in frame construction and for wiring in furred ceilings and above suspended ceilings. May be used for exposed work in unfinished areas where not subject to damage, but only upon prior approval by the Engineer.

3.08 PVC RACEWAYS

A. Use of PVC outside of building 5’ and beyond. See Plans for Special Applications.

B. PVC will only be used in underground applications or where specifically allowed on the plan sheet.

C. All bends shall be manufactured. Site-made heat bends may be approved by the Engineer on a case by case basis.

3.09 FLEXIBLE CONDUIT

A. Provide flexible raceway connection to motors and equipment subject to vibration with 90 degrees loop minimum to allow for isolation. Use liquid tight. Provide bonding jumper when required by code.

3.010 SURFACE METAL RACEWAYS
A. Install parallel to a building surface (i.e., wall, ceiling, floor). Fasten to surface as recommended by manufacturer. Mount so raceway is in the least visible location. Allowed only upon prior approval by Engineer.

3.011 UNDERGROUND CONDUIT

A. Install with minimum cover of 36” over PVC and 30” over (RGS) finished grade.

B. Install underground marking tape. Bury 6-8 inches below grade, directly above conduit.

C. Install with 3” per 100’ downward slope from buildings or section high points toward junction boxes, which are to be provided with drainage facilities.

D. Cap off watertight all conduits stubbed out for future use. Place #12 TW pull wire with tag at both ends.

E. Call for inspection prior to backfilling of any trenches, concrete pours containing conduits, and/or covering of conduits. Give a minimum of 48 hours notice prior to cover up.

F. Keep an accurate up-to-date location record of all underground and under floor conduits with dimensions from wall lines parallel and perpendicular.

G. Underground Marking Tape for all Underground Electrical. 6” wide, yellow, low density polyethylene, 4-mil thickness. Imprinted with ”CAUTION - STOP DIGGING - BURIED ELECTRIC LINE BELOW” and current date. Somerset “Protect-A-Line” or an approved equal. Tape for telephone, network and signal line similar except green. All underground wiring and cabling shall be in conduit.

3.012 RACEWAY BENDS

A. Conduit Bending. Bends in 1” size and larger shall be factory ells or made with manufactured mechanical bender. All entry ells shall be long radius type.

3.013 BUSHINGS

A. Factory insulated.

B. All panels, junction boxes and metal raceways shall have bushings when entered or exited by a conduit of any type.

3.014 RACEWAY SUPPORT DEVICES

A. All hardware such as inserts, straps, bolts, nuts, screws and washers shall be galvanized or stainless steel. No cadmium plated steel shall be allowed.

B. Trapeze Hangers, Channel. 1-1/2” x 1-1/2” galvanized or stainless, 12 gauge. Kindorf or an approved equal.

C. Rods. Minimum 3/8” diameter.

D. Beam Clamps. Hardened point set screws. Compatible with structural members.

E. Pipe Strap. Approved type. Perforated plumbers tape not acceptable.

3.015 RACEWAY SUPPORT AND INSTALLATION
A. Support conduits at intervals not greater than 10' and within 3' of any fitting, outlet or junction box, or cabinet, or as required by the NEC.

B. Secure single runs with pipe strap.

C. Hollow Masonry. Galvanized or stainless toggle bolts.

D. Concrete, Solid Masonry. Expansion shields and galvanized or stainless machine screws or standard preset inserts.

E. Metal Surfaces. Galvanized or stainless machine screws or bolts.

F. Wood Construction. Galvanized or stainless wood screws, or galvanized J-Nail.

G. Suspended from Ceiling. Pipe hanger and rod.

H. Damp Locations. Install clamp backs under each clamp on exposed surface conduits to prevent moisture accumulation.

I. Support multiple runs with trapeze hangers where conduits run exposed and parallel. Attach to structure with hanger rod as follows:
   1. Steel Members. Galvanized or stainless beam clamps.
   2. Concrete. Concrete inserts set flush with surface, insert reinforcing rod through insert opening where provided.
   3. Wood Framing. Ceiling hanger flange, galvanized or stainless wood screws.

J. When more than two conduits would use the same routing, group together on a patented channel support system (such as Unistrut).

K. Damp Locations. Install clamp backs under each clamp on exposed surface conduits to prevent moisture accumulation.

L. Run all exposed conduits parallel and plumb to structure lines. In building interior locations, conduits shall be concealed in walls or ceilings wherever possible and exposed work shall run parallel to building lines. Conduits shall not be routed on floors in areas subject to foot traffic. In exterior locations conduit shall be routed below grade. Where concrete or asphalt slabs exist they shall be saw cut, conduits installed, and the cut repaired to original condition. Exposed conduits and/or raceway shall be installed perpendicular or parallel to building lines.

M. Maintain 6" minimum separation from hot water lines. Do not run conduit beneath boilers or heating units.

3.016 SEALING OF RACEWAY PENETRATION

A. Exterior Wall Surfaces Above Grade. Seal around all penetrations with caulkling approved by Engineer. For concrete construction above ground level, cast raceway in wall or core drill wall and hard pack with a mixture of equal parts of sand and cement.

B. Exterior Surfaces Below Grade. Cast raceway into wall (or floor) or use manufactured seal assembly (such as OZ type "FSK") cast in place.
C. Roofs. Provide mopped, lead, roof jack where raceway penetrates roof membrane.

3.017 SEALING OF RACEWAYS

A. All conduits to and from hypochlorite generation room shall be sealed on both ends. Pack tightly around conductors in raceway. This includes all light fixture boxes, receptacle boxes, heater junction boxes and chlorinator junction boxes.

B. Both ends of conduits to and from reservoir control boxes shall be sealed on both ends.

C. Seal interior of all raceways which pass through building roof or through outside walls of the building, above or below grade. Seal on the end inside the building, using duct sealing mastic, non-hardening compound type, specially designed for such service. Pack around the wires in the raceways.

D. For exterior wall penetrations below grade, install OZ type “CSB” sealing bushing at interior end of penetrating raceway or an approved equal. Threaded fittings only are permitted in entering raceways ahead of the sealing bushing.

E. Appropriate sealing devices such as “EYS” series fittings, or approved equal shall be used where hazardous locations exist as classified by NEC.

3.018 HAZARDOUS AREAS

A. Sealing fittings will function to prevent the flow of water into the protected space either within the conduit or between the conduit and surrounding concrete wall or floor. In hazardous areas the seals will serve to minimize the passage of gases and vapors and prevent the passage of flames from one portion of electrical installation to another through the conduit.

B. Wall sealing fittings shall be O-Z/Gedney FSK series, or approved equal for new construction and CSM series, or approved equal for existing construction. At each wall sealing fitting provide an O-Z/Gedney, Crouse Hinds EYS series or an approved equal conduit seal fitting. Raceway stubups and stubouts shall have O-Z/Gedney CSB series conduit seals, or an approved equal together with the wall sealing fittings.

C. Through-Wall and Floor Seals for Sealing conduit Passing Through a Wall or Floor: OZ Gedney, Type FSK or an approved equal.

D. Conduit Sealing Bushings for Sealing Conductors within Conduit: OZ, or an approved equal.

3.019 CLEANUP

A. At time of final cleanup, thoroughly clean all raceways of any debris. This includes wire ends and pieces of insulation.

3.020 PAINTING

A. All exposed conduits on painted walls to be painted to match wall and trim colors.

B. See Basic Methods this Division.
PART 4     SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for the raceway and boxes and other work in this section shall be included as a portion of the lump sum for the Electrical, Wiring, Panels and Level Control as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 16131 - OUTLET AND PULL BOXES

PART 1   GENERAL

1.01 PROVIDE AS NEEDED OR SHOWN ON DRAWINGS

A. Provide outlet and pull boxes as required to enclose devices, permit pulling conductors and for wire splices and branches.

B. Provide all outlet and pull box appurtenances.

PART 2   PRODUCTS

2.01 OUTLET AND PULL BOX SIZES

A. Flush wall switch or receptacle to be 4 inch square, 1-1/2 inches or more deep, with single or two gang plaster ring mounted vertically except where noted to be mounted horizontally such as possibly counter back splashes. Where three or more devices are at one location, use one piece multiple gang box, with suitable plaster ring. Install not more than one device per gang unless otherwise noted on the plans.

B. Wall bracket and ceiling surface mounted lighting fixture outlet to be 4 inch octagon, 1-1/2 inches deep with 3/8 inch fixture stud where required. Wall bracket outlet to have single gang plaster ring.

C. Surface outlets where exposed conduit is allowed, to be same as flush outlet boxes without plaster ring but with cadmium or galvanized device plate.

D. Junction boxes for branch circuits to be not less than 4 inch square, 1-1/2 inches or more deep. Boxes with 1 inch conduit terminating in same, to be 4-11/16 inches square.

E. Liquid tight outlet and junction boxes to be 4 inches square, 1-1/2 inches or more deep and be fitted with neoprene gaskets. Outlet and junction boxes in filter room shall all be liquid tight.

F. Liquid tight PVC junction boxes shall be "Carlon" high impact gasketed PVC molded box with screwdown cover and stainless steel screws. Catalog No. E989R or equivalent. Exterior junction boxes may be PVC or galvanized as directed by Engineer.

G. Exterior exposed and equipment mounted junction boxes shall be cast electro galvanized, gasketed and painted to match equipment. Exterior junction boxes may be PVC or galvanized as directed by Engineer.

2.02 GREATER THAN 150 VOLTS

A. Device boxes containing multiple devices for system rated over 150 volts to ground are permitted only with steel barrier manufactured especially for the purpose of dividing the box into separate compartments for each device having exposed live parts.

2.03 IN CEILINGS

A. Junction or pull boxes in suspended ceilings shall be supported from structure independently from ceiling suspension system.

2.04 OUTLET BOX GROUNDING
A. All flush outlet boxes serving receptacles (12-V or more) shall be equipped with a green grounding screw.

2.05 DEVICE BOXES CONTAINING EMERGENCY AND NORMAL DEVICES.
A. Permitted only with steel barrier manufactured especially for the purpose of dividing the box into two completely separate compartments.

2.06 DEVICE BOXES CONTAINING POWER AND TELEPHONE OR TELEMETERING.
A. Permitted only with steel barrier manufactured especially for the purpose of dividing the box into two completely separate compartments.

PART 3 EXECUTION

3.01 PLUMB, SQUARE
A. All boxes to be fastened securely in place at the proper depth plumb with equipment, walls and fixtures for proper installation of switches, outlets and covers.

3.02 HARDWARE
A. All conduits shall be secure and attached to boxes with proper hardware.

3.03 REMOUNT
A. All boxes not meeting the above requirements shall be removed and remounted as directed by the Engineer or his representative.

3.04 FLUSH WITH WALL
A. Except for surface mounted boxes or boxes above accessible ceilings, all boxes shall have flush edge (box or plaster ring) even with the finished surface of the wall or ceiling.

3.05 ELECTRICAL WORK IN COUNTERBACKS, MILLWORK AND CASEWORK
A. Provide as shown and/or specified. Provide templates, where required, to other trades for drilling and cutting to insure accurate location of electrical fixtures (outlets and devices). Provide all wiring, devices, plates and connections as required by said fixtures.

3.06 CONNECTION TO EQUIPMENT
A. Furnished under this or other Divisions of the specifications, or by others. Provide outlet boxes of sizes and at locations necessary to serve such equipment. Outlet box required if equipment has pigtail wires for external connection, does not have space to accommodate circuits wiring or requires a wire different from circuit wiring used. Study equipment details to assure proper coordination.

3.07 BLANK COVERS
A. Provide blank covers or plate over all boxes that do no contain devices or are not covered by equipment.
B. No blank outlet and pull boxes will be allowed in finished walls or ceilings without permission from the Engineer.
3.08 LIGHTING FIXTURE BOXES

A. In ceilings of acoustical material. Locate in accordance with approved ceiling layout plans and so that fixtures replace full size ceiling tiles wherever possible.

3.09 ELECTRICAL OUTLETS

A. Coordinate the work of this Section with the work of other sections and trades. Study all drawings that form a part of this contract and confer with the various trades involved to eliminate conflicts between the work of this Section and the work of other trades. Check and verify outlet locations indicated on Architectural drawings, door swings, installation details and layouts of suspended ceilings and locations of all plumbing, heating and ventilating equipment.

B. Centered on Built-in Work. In the case of doors, cabinets, recessed or similar features, or where outlets are centered between two such features, such as between a door jamb and a cabinet, make these outlet locations exact. Relocate any outlets which are located off center.

C. Vertical and Horizontal Relationships. Where more than one outlet is shown or specified to be at the same elevation or one above the other, align them exactly on centerlines horizontally or vertically. Relocate as directed all such outlets (including lighting, receptacle, power, signal and thermostat outlets) which are not so installed, at no additional cost to Owner.

D. Device Outlet Height. Measure from the finished floor to the centerline, unless otherwise noted.

E. Switches: 4 feet, set vertically

F. Receptacles: 12 inches, set vertically or as indicated

G. Other: As shown on the plans or as directed by Engineer

H. Ceiling Location. For acoustical material locate outlet either at the corner joint or in the center of a panel, whichever is closer to the normal spacing. Locate all outlets in the same room in same panel position.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for the outlet and pull boxes and other work in this section shall be included as a portion of the lump sum for the Electrical, Wiring, Panels and Level Control as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTIONS 16140–WIRING DEVICES

PART 1  GENERAL

1.01  SUMMARY

A. Work consists of providing and installing switches, receptacles, and other devices shown on the drawings and specified herein.

B. Furnish and install wiring devices of number, rating and type shown on drawings or called out in these specifications.

C. Devices to include appropriate outlet box, cover, wall plate and other necessary installation materials for a complete and satisfactory operation system.

D. In general, all devices shall be by one manufacturer unless specifically called out otherwise in these specifications or on drawings.

PART 2  PRODUCTS

2.01  APPROVED DEVICES

A. Manufacturer's with equivalent devices meeting specifications. Bryant, Hubbell, Arrowhart, Leviton, additional manufactures and products can be used upon review and approval as equivalent. Numbers have been listed as to style, grade and as a guide.

   a. Single Pole. Hubbell; 20 amp, 120/277 VAC.
   b. 3 Way. Hubbell; 20 amp, 120/277 VAC.
   c. 4 Way. Hubbell; 20 amp, 120/277 AC.

   a. Single. Hubbell; 20 amp, 125VAC.
   b. Duplex. Hubbell; 20 amp, 125VAC.

3. Receptacles. 50amp Welding,  
   a. Single. Leviton 5374 NEMA6-50R 50 amp, 250VAC.

4. Combination Devices.
   a. Combination Switch and Receptacle. Hubbell; 20 amp 125VAC receptacle and switch.
   b. Two Single Pole Switches. Hubbell; 20 amp, 120/277VAC.

5. Groundfault Interrupter Receptacle.
   a. Duplex Receptacle, Hubbell 20 amp, 125VAC, GF15 Series.
6. Cover Plates.
   a. Nonconductive smooth plastic. All switches and dimmers to be gauged and covered by one plate. All wall plates to be standard size and meeting Federal specification WW-455A noncombustible, supplied with metal mounting screws matching color of plate. Hubbell NP Series - match existing. All switches and devices shall be ganged wherever possible.
   b. Engraved Device Wall Plates. Unless shown otherwise, provide engraved plates for panels and devices. Letter height shall be 3/16” (minimum), color of filling to be white or black, as appropriate for contrast. Before ordering, submit a sample of the above wall plate with engraving. A name plate schedule will be supplied by Engineer at the time of submittal.
   c. Weather Resistant (WP) Cover Plates. Hubbell; self-closing HBL5221, provide appropriate gasket to box.
   d. Cover plates in unfinished areas and where exposed conduit is used.
      1) Raised galvanized to be used in unfinished areas or where conduits run exposed. Labeling of switch shall be by Melamine Plate attached to cover plate. Verify areas with Engineer prior to installation of cover plates.

2.02 PLUG MOLD
   A. Provide plug mold for surface mounting as shown on drawings, with proper number of receptacles as shown. All plug molds to be grounded. Submit plug mold with wiring devices.

PART 3 EXECUTION

3.01 INSTALLATION
   A. Devices and finish plates shall be installed plumb with building lines.
   B. Finish plates and devices shall not be installed until final painting is complete. Scratched or splattered finish plates and devices will not be accepted.
   C. Wall mounted receptacles shall be installed vertical 48” above floor, or as shown.
   D. Receptacles shall be checked for line to neutral, line to ground and neutral to ground integrity.
   E. Install GFI receptacle circuits at all locations.
4.01 MEASUREMENT AND PAYMENT

A. Payment for Wiring Devices, and other work in this section shall be included within the lump sum items for Electrical, Wiring, Panels, and Level Controls in the Bid Form, and shall include, but not be limited to, compensation for all labor, material, and equipment required for the construction/installation of the work described herein.

END OF SECTION
SECTION 16210 – POWER UTILITY SERVICE

PART 1  GENERAL

1.01 UTILITY COMPANY

A. See electrical one-line diagrams and electrical site diagrams for additional information.

B. Utility company will provide pad mounted transformers and cabinet where necessary and install conductor wiring.

C. Contractor will provide underground conduit between transformers and meter base, the meter base and install ground rods and ground wiring to vaults.

D. Utility company will install wiring and meter on meter base. Coordinate down time and switch over with Utility for each meter base.

E. Utility Company Fees, shall be included as part of the contract.

1. Contractor shall pay utility fees associated with the project and ownership shall be transferred to the City at the end of the Project. Estimated utility fees are $37,473, not including not include the trench, conduit, cabinet vault/grounds, transformer vault/grounds, or meter base.

1.02 RELATED SECTIONS

A. Section 16050 - Electrical Introduction

1.03 WORK INCLUDED

A. The Division 16 contractor shall furnish and install all service equipment, raceway, transformers, etc., as shall be required by the power utility company to make a complete, operable power system, as further described in the contract documents.

B. Contractor shall pay all fees, connect charges, permits, etc., as may be required to provide service to the project (see above).

C. Contractor shall be responsible for ordering service changes and coordinating all service related work with the General Contractor and the operator so as to provide uninterrupted plant processes and smooth transitions from old services to new.

D. Contractor shall install trench and conduit per EPUD’s specifications.

E. Contractor shall be responsible for planning, ordering and paying for all temporary power services as may be needed during construction.

END OF SECTION
SECTION 16230 – STANDBY GENERATOR

PART 1    GENERAL

1.01  SCOPE

The standby power generator shall be a 4-cycle LP engine generator set with, sized as specified herein. Genset minimum ratings: 80 kW, 100 kVA at 0.80 PF rating, based on site conditions noted below. System voltage of: 480 Volts AC, three phase, four-wire, 60 hertz.

A. The engine generator set shall be capable of producing the rated kW and kVA when operating at 390 feet altitude and an ambient temperature up to 50° C (122° F). The manufacturer shall provide data to verify the set will operate as required in the specified ambient conditions.

B. Provide complete factory built generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.

C. Provide factory test, startup by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.

D. The generator set manufacturer shall warrant all equipment provided under this section 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.

1.02  CODES AND STANDARDS

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable. The generator set shall include necessary features to meet the requirements of these standards.


2. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

3. NFPA37 – Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines

4. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

5. NFPA99 – Essential Electrical Systems for Health Care Facilities

6. NFPA110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

B. The generator set and supplied accessories shall meet the requirements of the following standards:
1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.

2. UL1236 – Battery Chargers

3. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

C. The control system for the generator set shall comply with the following requirements.

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.


3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

4. FCC Part 15, Subpart B.

5. IEC8528 part 4. Control Systems for Generator Sets

6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.

7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.

8. UL1236 – Battery Chargers.

D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.03 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers include Cummins, Generac, Kohler, and Caterpillar. Other manufacturers capable of producing equipment equal to or greater in quality than that described herein shall be pre-approved by the Engineer.

1.04 SUBMITTALS

A. The generator proposed for this project must be preapproved through the submittal process as outlined in Section 01300.

B. Submittal shall include: prototype test certification showing all standard and optional accessories to be furnished, schematic wiring diagrams, dimensional drawings, installation instructions, interconnection diagrams identified by terminal number, and each required interconnection between the generator set, and the transfer switch.

C. Generator manufacturer shall supply seismic pad dimensions, concrete strength and reinforcement for the applicable generator model. Professional drawings from a professional engineer registered in Oregon for the construction of the seismic pad shall be provided by the manufacturer. Risk Factor: 3, Seismic Zone: E.
PART 2 PRODUCTS

2.01 GENERATOR SET

A. Ratings

1. The generator set shall operate at 1800 rpm and at a voltage of 480 Volts AC, three phase, 60 hertz.

2. The generator set shall be rated at minimum 80 kW, 100 kVA at 0.8 PF, standby rating, based on site conditions of: Altitude 390 ft, ambient temperatures up to 50° C (122° F).

3. The generator set rating shall be based on standby service.

B. Performance

1. Voltage regulation shall be plus or minus 1.0 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 1.0 percent.

2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.

3. The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

4. Motor starting capability shall be a minimum of 422 kVA. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.

5. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall be less than 40.

C. Construction

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

D. Connections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
2. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.

3. Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.02 ENGINE AND ENGINE EQUIPMENT

A. The engine shall be LP fueled, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Engine accessories and features shall include:

1. Complete engine fuel system, including all pressure regulators, strainers, and control valves. The fuel system shall be plumbed to the generator set skid for ease of site connections to the generator set.

2. An electronic governor system shall provide automatic isochronous frequency regulation. 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 and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.

3. Skid-mounted radiator and cooling system rated for full load operation in 104 degrees F (40 degrees C) ambient as measured at the generator air inlet, based on 0.5 in H2O external static head. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture. Rotating parts shall be guarded against accidental contact.

4. Electric starter(s) capable of three complete cranking cycles without overheating.

5. Positive displacement, mechanical, full pressure, lubrication oil pump.

6. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

7. Replaceable dry element air cleaner with restriction indicator.

8. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.

9. Coolant heater

   a. Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.

   b. The coolant heater shall be installed on the engine with high temperature silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds
12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

c. The coolant heater shall be provided with a thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

d. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100°F (40°C) in a 40°F ambient, in compliance with NFPA 110 requirements, or the temperature required for starting and load pickup requirements of this specification.

10. Provide vibration isolators, spring/pad type or as recommended by the manufacturer, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.

11. Starting and Control Batteries shall be calcium/lead antimony type, sized as recommended by the engine manufacturer, complete with battery cables and connectors.

12. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. Exhaust system shall be installed according to the engine manufacturer’s recommendations and applicable codes and standards.

B. BATTERY CHARGER – Provide a minimum 52 amp battery charger for each generator set battery bank. Generator sets incorporating two battery banks shall be provided with two chargers connected together and operating in parallel, with alarm output(s) connected in parallel. The charger(s) shall include the following capabilities:

1. Chargers shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.

2. The charger shall be compliant with UL991 requirements for vibration resistance.

3. The charger shall comply with the requirements of EN61000-4-5 for voltage surge resistance; EN50082-2 for immunity; EN61000-4-2 for ESD; EN61000-4-3 for radiated immunity; ANSI/IEEE C62.41 category B and IN61000-4-4 for electrically fast transient; EN61000-4-6 for conducted emissions; and FCC Part 15 Class A for radiated emissions.

4. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL-labeled with the maximum battery amp-hour rating that can be recharged within 24 hours.

5. The charger shall incorporate a 4-state charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge after normal discharge, an absorption state to return the battery to 100 percent of charge, and a float stage to maintain a fully charge battery and supply battery loads when the generator set is not operating. In
addition, the charger shall include an equalization timer. Charge rates shall be
temperature compensated based on the temperature directly sensed at the
battery.

6. The DC output voltage regulation shall be within plus or minus 1%. The DC
output ripple current shall not exceed 1 amp at rated output current level.

7. The charger shall include the following features:
   a. Two line alphanumeric display with programming keys to allow display of
      DC output ammeter and voltmeters (5% accuracy or better), display
      alarm messages, and perform programming;
   b. LED indicating lamp(s) to indicating normal charging condition (green),
      equalize charge state (amber), and fault condition (red);
   c. AC input overcurrent, over voltage, and undervoltage protection;
   d. DC output overcurrent protection;
   e. Alarm output relay;
   f. Corrosion resistant aluminum enclosure.

2.03 AC GENERATOR

A. The AC generator shall be: synchronous, four pole, 2/3 pitch, revolving field, drip-proof
construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal
blower fan, and directly connected to the engine with flexible drive disc. All insulation
system components shall meet NEMA MG1 temperature limits for Class H insulation
system. Actual temperature rise measured by resistance method at full load shall not
exceed 120° C.

B. The generator shall be capable of delivering rated output (kVA) at rated frequency and
power factor, at any voltage not more than 5 percent above or below rated voltage.

C. A permanent magnet generator (PMG) shall be included to provide a reliable source of
excitation power for optimum motor starting and short circuit performance. The PMG and
controls shall be capable of sustaining and regulating current supplied to a single phase
or three phase fault at approximately 300% of rated current for not more than 10
seconds.

D. The subtransient reactance of the alternator shall not exceed 15 percent, based on the
standby rating of the generator set.

E. The alternator shall be configured with 12-lead wiring.

2.04 GENERATOR SET CONTROL

A. The generator set shall be provided with a microprocessor-based control system that is
designed to provide automatic starting, monitoring, and control functions for the generator
set. The control system shall also be designed to allow local monitoring and control of
the generator set, and remote monitoring and control as described in this specification.
B. The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

C. The generator set mounted control shall include the following features and functions:

1. Control Switches

   a. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

   b. EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

   c. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

   d. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

2. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

   a. Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.

   b. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.

   c. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.
d. The control system shall log total number of operating hours, total kWH, and total control on hours, as well as total values since reset.

3. Generator Set Alarm and Status Display

a. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:

1) The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown function monitored by the genset. They shall also be configurable for color, and control action (status, warning, or shutdown).

2) The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.

3) The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.

4) The control shall include an amber common warning indication lamp.

b. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:

1) low oil pressure (warning)

2) low oil pressure (shutdown)

3) oil pressure sender failure (warning)

4) low coolant temperature (warning)

5) high coolant temperature (warning)

6) high coolant temperature (shutdown)

7) high oil temperature (warning)

8) engine temperature sender failure (warning)

9) low coolant level (warning)

10) fail to crank (shutdown)

11) fail to start/overcrank (shutdown)

12) overspeed (shutdown)

13) low DC voltage (warning)
14) high DC voltage (warning)
15) weak battery (warning)
16) high AC voltage (shutdown)
17) low AC voltage (shutdown)
18) under frequency (shutdown)
19) over current (warning)
20) over current (shutdown)
21) short circuit (shutdown)
22) over load (warning)
23) emergency stop (shutdown)
24) (4) configurable conditions

c. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

4. Engine Status Monitoring

a. The following information shall be available from a digital status panel on the generator set control:

1) engine oil pressure (psi or kPA)
2) engine coolant temperature (degrees F or C)
3) engine oil temperature (degrees F or C)
4) engine speed (rpm)
5) number of hours of operation (hours)
6) number of start attempts
7) battery voltage (DC volts)

b. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

D. Engine Control Functions
1. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.

2. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

3. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

4. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

5. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

E. Alternator Control Functions

1. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

2. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445. The protection for this function shall be 3rd party certified to verify performance.

3. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445. The protection for this function shall be 3rd party certified to verify performance.
4. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

5. A line to neutral sensing AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

6. When required by National Electrical Code or indicated on project drawings, the control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

7. The generator set control shall include a 120VAC-control heater.

F. Other Control Functions

1. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage are outside preset limits. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

G. Control Interfaces for Remote Monitoring

1. The control system shall provide four programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control. The relays shall be configured to indicate: (1) generator set operating at rated voltage and frequency, (2) common warning, (3) common shutdown, (4) load shed command.

2. A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.

3. A fused 10 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.

2.05 OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET

A. The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.
2.06 FACTORY TESTING

A. The generator set supplier shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided. Equipment supplied shall be fully tested at the factory for function and performance.

B. Factory testing may be witnessed by the owner and consulting engineer. Costs for travel expenses will be the responsibility of the owner and consulting engineer. Supplier is responsible to provide two weeks' notice for testing.

C. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

2.07 ONSITE ACCEPTANCE TEST

A. The complete installation shall be tested for compliance with the 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.

B. Installation acceptance tests to be conducted on-site shall include a "cold start" test, a two hour full load 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.

C. 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.

2.08 Warranty

A. The generator set and associated equipment shall be warranted for a period of not less than 5 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

PART 3 EXECUTION

3.01 SEQUENCE OF OPERATION

A. Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control and a redundant signal over the required network connection.

B. The generator set shall complete a time delay start period as programmed into the control.

C. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:
1. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate “fail to crank" shutdown.

2. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate “fail to start”.

3. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

D. On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand, or load govern state.

E. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

F. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.

1. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

3.02 INSTALLATION

A. 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. Install equipment in accordance with manufacturer’s instructions and instructions included in the listing or labeling of UL listed products.

B. 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.

C. 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.

D. If local building inspector requires it, Contractor shall supply generator housekeeping pad seismic calculations by a licensed Oregon Professional Engineer showing required reinforcement and anchor bolt locations, as well as pad thickness and compressive strength. Contractor shall also supply testing lab shake table sheet for a licensed Engineer that equipment meets seismic requirement or is listed a rugged equipment exempt from testing.
E. Equipment shall be initially started and operated by representatives of the manufacturer.

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 final testing of the system.

G. Equipment shall be installed in a weather enclosure from the generator manufacture.

3.03 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.

3.04 SERVICE AND SUPPORT

A. The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

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 replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for the standby generator and other work in this section shall be included as a portion of the lump sum for the Standby Generator and Propane Tank items as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 16400 - SERVICE AND DISTRIBUTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 GENERAL REQUIREMENTS

A. Refer to General Provisions, Section 16050 of specifications.

B. System of Distribution:
   1. 277/480V., 3 phase, 4 wire Delta

PART 2 PRODUCTS

2.01 GENERAL

A. Refer to Basic Materials & Methods, Section 16050 of specifications.

2.02 PRODUCTS

A. Metering: Provide metering as required by serving utility, loads, equipment and appliances shown.

B. Grounding: Provide service and equipment grounds per code requirements.

C. Panel Boards: Panel Boards to be flush or surface mounted as indicated with flush lift latches with typewritten protected circuit schedules listing each circuit. Panel Boards to be circuit breaker type, bolt to buss, copper bus only, equipped with grounded bars.

D. Circuit Breaker: Minimum width of circuit breakers shall be ¾", no twins. Minimum interrupting capacity shall be 22,000 amperes.

E. Manufacturer: ITE, Square "D", Cutter-Hammer, G.E., Sylvania, Westinghouse, or approved.

F. Meter Base:
   1. NEMA 3R rated
   2. Overhead service
   3. Single phase or three phase as required. Single phase shall be self-contained and 3-phase Delta shall be 7 terminal.
   4. Acceptable to Utility, coordinate with EPUD
   5. UL Listed
   6. Rated and labeled for copper and aluminum conductors
2.03 POWER SYSTEM

A. Run circuits to equipment furnished by Mechanical Contractor and connect as required for finished job.

B. Mount and wire all line voltage starters, pushbutton stations, or other control or protective devices furnished by Mechanical Contractor and furnish and install necessary incidental devices, materials and labor required for complete job.

C. Installation and connection of low voltage control wiring responsibility of Mechanical Contractor.

D. Furnish and install required or necessary disconnecting means to comply with code requirements whether specifically shown or not.

E. Disconnecting switches for 240 volt motors: ITE, Imperial, Westinghouse, General Electric, Square "D", or approved. Exterior switches shall have NEMA 4X rain tight enclosures.

F. Disconnecting switches for 120 volt motors _HP and smaller shall be 20 amp, 125 volt SPST toggle type with thermal overload heaters except that where thermal overload heaters are otherwise provided, disconnect may be 20 amp, SPST switch.

PART 3 EXECUTION

3.01 GENERAL

A. Install panel boards and fasten them to building structure independently of the conduits and conductors that enter them. Provide non-vibrating supports.

B. Install circuit breakers and conductors as indicated on the plans.

3.02 GROUNDING

A. All conduit systems, supports, cabinets, equipment cases, motor frames and system neutral conductors shall be permanently and effectively grounded. Continuity of equipment ground shall be maintained throughout the system. Ground clamps shall be approved types specifically designated for grounding. Where the grounding conductor is enclosed in conduit, ground clamp shall be of type which grounds both the conductor and conduit. Copper-clad strap metal is not acceptable for grounding or bonding purposes.

B. Grounding shall meet all code requirements. Where other approved grounding means are not available, ground rods shall be used. All ground rods shall be ¾" x 10'-0" copper clad steel. Two ground rods shall be installed (if required) to obtain proper grounding per code requirements. Space a minimum of 6'-0" apart where two rods are used.

3.03 POWER SYSTEM

A. Provide including service to each power unit and line voltage control wiring.

B. Mechanical Contractor will provide motors, motor starters and low voltage control wiring and components as specified in Division 15.

C. Provide flexible conduit connection minimum length ten (10) times diameter of conduit,
at each motor.

D. Obtain from Mechanical Contractor complete wiring details; wire components in accordance with diagrams. Provide motor disconnects whether specifically shown or not.

E. Connect equipment requiring electrical connections.

F. After connecting, test for proper operation.

3.04 PANEL BOARDS

A. Panel boards shall be mounted as shown on drawings. Install with top of enclosure 6'-8" above finished floor.

B. Balance electrical loads to all panel boards. Check rotation of all motors and, if necessary, correct after final service connections are made.

3.05 UNDERGROUND WORK

A. Electrical Contractor shall be responsible for coordination of all excavating, concrete work and backfilling (unless otherwise noted) with General Contractor. Trenching, backfilling, shoring and compacting shall be in accordance with Section 02315 of this Specification. Electrical Contractor shall furnish and install all conduit, fitting and grounding, unless otherwise noted.

**PART 4 SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Payment for the service and distribution and other work in this section shall be included as a portion of the lump sum price for the Electrical, Wiring, Panels and Level Control as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 16410—ENCLOSED SWITCHES AND BREAKERS

PART 1  GENERAL

1.01  WORK INCLUDED

A.  Provide all disconnects, fused and unfused, required by code for equipment furnished under this and other Divisions of these specifications.

PART 2  PRODUCTS

2.01  DESCRIPTION

A.  Switch shall be heavy duty type, shall be quick-make, quick-break and shall be horsepower rated.  Switch shall have copper blades as required to open all ungrounded conductors and shall be single throw unless noted.

B.  Enclosure shall have interlocking cover to prevent opening door when switch is closed.  Interlock shall include a defeating scheme.

C.  Enclosure shall be suitable for location in which mounted.

D.  Fusible disconnects shall be as above with addition of fuse space and clips to accept only Class R fuses.

E.  Enclosure shall have provisions for a padlock.

F.  Labels.

1.  All labels shall be laminated plastic and attached directly to the cover.

2.  Include the following information on the labels:  Load served, proper voltage and phase.

G.  Disconnects shall be:

1.  600 VAC rated, ampacity rated to match circuit on contract drawings.

2.  NEMA Type 4X.


4.  Three pole or two pole as needed, with neutral

5.  Surface Mounted

6.  Siemens Catalog Number HNF or 3LD2 series; or approved equal.

H.  Disconnects shall be provided at all motor locations where the load is remotely located from the room the breaker panel is located in.  Manufacturer provided equipment shall come already equipped with disconnects.
PART 3  EXECUTION AND WORKMANSHIP

3.01 MOUNTING

A. Secure solidly to wall or approved mounting frame. Disconnects supported only by raceway are not acceptable.

PART 4  SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for the enclosed switches and breakers and other work in this section shall be included as a portion of the lump sum price for Electrical, Wiring, Panels and Level Control as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 16411– FUSES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide all fuses as required. Fuses shall be UL Class R rejection type with characteristics noted below unless otherwise noted in the diagrams.

PART 2 PRODUCT

2.01 DESCRIPTION

A. Fuses. All fuses shall be current limiting type unless specified otherwise. Class K1 for all except motor circuits; Class K5 motor load type for motors. Provide 10% spare fuses, but not less than ten (10) of any one size and type.

B. Provide a laminated plastic label and attach directly to the cover of fused enclosures.

PART 3 EXECUTION

3.01 DESCRIPTION

A. Fuses. Install in all fusible devices provided under this contract.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for the fuses and other work in this section shall be included as a portion of the lump sum or unit price for the items requiring fuses within the project as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
DIVISION 16415 – AUTOMATIC TRANSFER SWITCH (ATS)

PART 1   GENERAL

1.01   SCOPE

A. Provide complete factory assembled power transfer equipment with field programmable
digital electronic controls designed for fully automatic operation and including: surge
voltage isolation, voltage sensors on all phases of both sources, linear operator,
permanently attached manual handles, positive mechanical and electrical interlocking,
and mechanically held contacts for both sources.

B. The generator set manufacturer shall warrant transfer switches to provide a single source
of responsibility for all the products provided. Technicians specifically trained to support
the product and employed by the generator set supplier shall service the transfer
switches. Technicians shall have passed qualification examinations on the product, and
be certified by the manufacturer as capable of effectively servicing the equipment
provided.

1.02   RELATED SECTIONS

A. Section 16230 – Standby Generator

B. Division 16 – Electrical

1.03   CODES AND STANDARDS

A. The automatic transfer switch installation and application shall conform to the
requirements of the following codes and standards:


2. NFPA70 – National Electrical Code. Equipment shall be suitable for use in
   systems in compliance to Article 700, 701, and 702.

3. NFPA99 – Essential Electrical Systems for Health Care Facilities

4. NFPA110 – Emergency and Standby Power Systems. The transfer switch shall
   meet all requirements for Level 1 systems.

5. IEEE446 – Recommended Practice for Emergency and Standby Power Systems
   for Commercial and Industrial Applications.


B. The transfer switch assembly shall comply with the following standards:

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.

2. EN55011, Class B Radiated Emissions

3. EN55011, Class B Conducted Emissions

4. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity.
5. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
6. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
7. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
8. IEC 1000-4-6 Conducted Field Immunity
9. IEC 1000-4-11 Voltage Dip Immunity.
12. UL1008 – Transfer Switches. Transfer switches shall be UL1008 listed. UL1008 transfer switches may be supplied in UL891 enclosures if necessary to meet the physical requirements of the project.

C. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.04 ACCEPTABLE MANUFACTURERS

A. The Automatic Transfer Switch shall be provided by the same supplier that supplies the onsite generation equipment as a package.

B. Acceptable manufacturers of automatic transfer switches include Cummins, Onan, Caterpillar, Kohler or preapproved equal.

PART 2 PRODUCTS

2.01 POWER TRANSFER SWITCH

A. Ratings

1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.

2. Main contacts shall be rated for 600 Volts AC minimum.

3. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of 40 to +60 degrees C, relative humidity up to 95% (non condensing), and altitudes up to 10,000 feet (3000M).

4. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes greater than the available fault currents shown on the drawings and at the specified voltage. The transfer switch and its upstream protection shall be coordinated. The transfer switch shall be third party listed and labeled for use with the specific protective device(s) installed in the application.
B. Construction

1. Transfer switches shall be double throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.

2. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick break, quick make over center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.

3. Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.

4. Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.

5. Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.

6. Transfer switches designated on the drawings as 4 pole shall be provided with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Substitute equipment using overlapping neutral contacts is not acceptable.

7. Transfer switches shall come without an enclosure and mount within the frame of the main switchboard located within the Control Building.

C. Connections

1. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

2. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.

2.02 TRANSFER SWITCH CONTROL

A. Operator Panel. Each transfer switch shall be provided with a microprocessor based control panel using a test display to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better (regardless of enclosure rating) that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.
1. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.

2. High intensity LED lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch (when used) enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.

3. “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.

4. “TEST” pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.

5. “RESET/LAMP TEST” push-button that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.

6. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via a PC-based service tool and an operator display panel.

7. Analog AC meter display panel, to display AC Amps, AC Volts, Hz, KW load level, and load power factor. The display shall be color-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.

8. Vacuum fluorescent alphanumeric display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The Alphanumeric display panel shall be capable of providing the following functions and capabilities:

   a. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Line to neutral voltages shall be displayed.

   b. Display source status, to indicate source is connected or not connected.

   c. Display load data, including AC voltage, AC current, frequency, KW, KVA, and power factor. Voltage and current data for all phases shall be displayed on a single screen.

   d. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:

      1) Set nominal voltage and frequency for the transfer switch.

      2) Adjust voltage and frequency sensor operation set points.
3) Set up time clock functions.

4) Set up load sequence functions.

5) Enable or disable control functions in the transfer switch, including program transition.

6) Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.

e. Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.

f. Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.

g. Display information for other transfer switches in the system, including transfer switch name, real time load in KW on the transfer switch, current source condition, and current operating mode.

h. Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low and network communications error.

B. Internal Controls

1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.

2. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:

a. Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).

b. Monitoring of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).
c. Monitoring of the normal service (source 1) and emergency service (source 2) for voltage imbalance.

d. Monitoring of the normal service (source 1) and emergency service (source 2) for loss of a single phase.

e. Monitoring of the normal service (source 1) and emergency service (source 2) for phase rotation.

f. Monitoring of the normal service (source 1) and emergency service (source 2) for over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level).

g. Monitoring of the normal service (source 1) and emergency service (source 2) for over or under frequency conditions.

h. Monitoring the neutral current flow in the load side of the transfer switch. The control shall initiate an alarm when the neutral current exceeds a preset adjustable value in the range of 100-150% of rated phase current for more than an adjustable time period of 10 to 60 seconds.

3. All transfer switch sensing shall be configurable from a Windows PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.

4. The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.

5. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cooldown) (adjustable in a range of 0-30 minutes).

6. The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.

7. The transfer switch shall provide a relay contact signal prior to transfer or retransfer. The time period before and after transfer shall be adjustable in a range of 0 to 50 seconds.

8. The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.

9. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
10. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational. The battery power supply shall be monitored for proper condition, and the transfer switch shall include an alarm condition to indicate low battery condition.

C. Control Interface

1. The transfer switch will provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.

2. Provide an annunciator panel matched with the genset to provide standard alarm conditions. Annunciator shall include lighted display marking individual alarm conditions for troubleshoot. If control interface can display these conditions without manually cycling through each alarm on screen that shall be considered equal.

3. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

4. The transfer switch shall provide relay contacts to indicate the following conditions: source 1 available, load connected to source 1, source 2 available, source 2 connected to load.

5. The transfer switch shall be provided with an Ethernet port for SCADA monitoring and control of the Generator set.

   a. SCADA system shall monitor and display ATS status, all active alarms, and alarm history with specific times recorded.

   b. Load connection mode shall be displayed.

2.03 ENCLOSURE

A. The transfer switch shall be provided with a Nema 12 enclosure. Control panel display and annunciator functions shall be mounted adjacent to and displayed on the front panel without the need for the operator to open the panel.

2.04 FACTORY TESTING.

A. The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. A certified test report shall be available on request. Test process shall include calibration of voltage sensors.

PART 3 EXECUTION

3.01 OPEN TRANSITION SEQUENCE OF OPERATION

A. Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to the loads when normal source fails. The normal position of the transfer switch is source 1 (connected to the utility), and no start signal is supplied to the genset.
B. Generator Set Exercise (Test) With Load Mode. The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:

1. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.

2. The transfer switch shall issue a compatible start command to the generator set, and cause the generator set to start and run at idle until it has reached normal operating temperature.

3. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.

4. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.

5. The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the loads to the normal service.

6. On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.

7. The transfer switch shall operate the generator set unloaded for a cool down period, and then remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

C. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:

1. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.

2. The transfer switch shall issue a compatible start command to the generator set, and cause the generator set to start and run at idle until it has reached normal operating temperature.

3. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.

4. When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.
5. At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

**PART 4 SPECIAL PROVISIONS**

4.01 SERVICE AND SUPPORT

A. The manufacturer of the transfer switch shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The transfer switch shall be serviced by a local service organization that is trained and factory certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

D. The manufacturer shall supply to the facility owner a complete set of service and maintenance software for use in properly supporting the product. The software shall be provided at a training class attended by the user, to qualify the user in proper use of the software. The software shall have the following features and capabilities:

1. The software shall be Windows compatible.

2. The software shall use the Windows “Explorer” format, for ease of use and commonality with other software in use at the facility.

3. The software shall allow adjustment of all functions described herein via the tool; adjustment of operating levels of all protective functions; and programming of all optional functions in the controller. Adjustments shall be possible over modem from a facility that is remote from the generator set.

4. The software shall allow simulation of fault conditions, to verify operation of all protective devices.

5. The software shall include the ability to store and display data for any function monitored by the generator set control. This data shall be available in common file formats, and on graphical “strip chart” displays.

6. The software shall automatically record all control operations and adjustments performed by any operator or software user, for tracking of changes to the control.

7. The software shall display all warning, shutdown, and status changes programmed into transfer switch controller. For each event, the control shall provide information on the nature of the event, when it last occurred, and how many times it has occurred.

8. The software shall include detailed operation and service information on the specific generator set supplied, so that no other documentation (other than schematic and wiring diagram drawings) is necessary for service of the product.
E. 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.

4.02 MEASUREMENT AND PAYMENT

A. Payment for the ATS and other work in this section shall be included as a portion of the lump sum or unit price for the items requiring an ATS within the project as stated in the Bid Form. No separate measurement or payment for these quantities will occur.
SECTION 16424 – VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.01 SCOPE
   A. Provide variable frequency drives (VFDs) for devices as indicated on drawings or other Sections of Specifications. Locate as per drawings.

1.02 CODES AND STANDARDS
   A. The Drive manufacturing facility shall be ISO 9002 certified.
   B. The VFD shall be UL listed.

1.03 ACCEPTABLE MANUFACTURERS
   A. Acceptable manufacturers are Allen Bradley Powerflex 700.

1.04 SUBMITTALS
   A. The Variable Frequency Drive proposed for this Section must be pre-approved through the pre-bid submittal process as outlined in Section 01300.

1.05 TESTING AND QUALITY ASSURANCE
   A. All printing circuit boards shall be completely testing and burned-in before being assembled into the completed Drive. The Drive shall then be subjected to a preliminary functional test, minimum one hour burn-in and computerized final test. The burn-in shall be at 104°F, at full rated load, or cycled load. Drive input power shall be continuously cycled for maximum stress and thermal variation.
   B. Drive manufacturer shall conduct complete electrical testing, component x-ray, component decap or delamination and failure analysis by qualified individuals in the case of drive component failure.

PART 2 - PRODUCTS

2.01 DRIVE GENERAL REQUIREMENTS
   A. The adjustable frequency controller shall be microprocessor-based, pulse width modulated design with switching logic power supply operating from the DC bus. The controller shall produce an adjustable AC voltage/frequency output so to vary the speed of the driven equipment. User Interface shall be common for all horsepower ratings The controller shall consist of the following sections:

1. The controller switching frequency shall be adjustable and permit standard operation at 5,000 Hertz or less. The switching technology shall also include a scheme specifically design to reduce the dv/dt of the output supply.
2. The controller shall be equipped with a minimum of three percent DC bus reactor or input line reactor.
3. The controllers’ solid state converter input rectifier devices shall have a 1600 volt PIV rating.
4. The controller shall have an overload rating of 110% variable torque, 150% constant torque for one minute.

5. RMS harmonic content of output current shall be less than five percent of fundamental current.

6. Controller shall be able to withstand repeated output terminal line-to-line short circuits without component failure.

2.02 ENCLOSURE

A. Each variable frequency drive shall be provided with a free floor standing or wall mount enclosure with front access, suitable for mounting all components required of a given unit. Enclosures shall be provided to meet NEMA /UL type 1 or NEMA / UL type 12 as specified.

B. Each drive may alternatively be mounted in a single control cabinet with UL approved partitioning from low voltage control circuits.

C. Enclosure / cooling fans and filter ratings.

1. Each enclosure shall provide adequate cooling for the components within and shall include positive ventilation. On NEMA / UL type 12 enclosures, all filters shall meet the strict requirements of UL certification for type 12 enclosures. NEMA 12 enclosures with NEMA 1 filters are not acceptable.

2. All enclosures shall be equipped with a fan control scheme to reduce filter maintenance, increase fan life, decrease audible noise and save energy. This is to be accomplished by employing a control relay to disable enclosure fans when drives are not in run mode.

D. Each enclosure shall include a pad-lockable circuit breaker.

E. Each enclosure door shall have a mounted operator interface / digital keypad and display.

E. Nameplates for identification of equipment and operating functions shall be included on cabinet door as specified.

2.03 CONTROLLER

A. Environment

1. The controller’s operating criteria shall be in accordance with the following.

   a. Operational ambient temperature range, 0°C to 40°C. Storage ambient temperature range: -40°C to 70°C (-40°F to 158°F). The relative humidity range is 5% to 95% non-condensing.

   b. Operational humidity, up to 90 percent non-condensing.

   c. Altitude, below 3,300 feet above sea level

   d. De-rating values for operation above 3,300 feet.

   e. Nominal frequency, 60 Hertz plus or minus 3 Hz.

   f. Shock: 15G peak for 11ms duration.
g. Vibration: 0.152 mm (0.006 inches) displacement, 1G peak

h. Efficiency, 97.5% percent at full speed and full load. (Reduced efficiency of 6.5 for low harmonic options.)

B. Input Power

1. The drive(s) shall be supplied as 6 or 18 pulse in configured packages. Nominal voltage, 480 volts plus ten percent or minus five percent, 3-phase, 3 wire. The controller shall include an under-voltage feature to permit trip-free operation down to 35 percent under-voltage.

2. Displacement power factor for 6 and 18 pulse converters shall be limited to between 1.0 and 0.95, lagging, over the entire speed range.

3. For 6 pulse drives with passive harmonic filters, a contactor circuit shall be present to reduce leading power factor under light or no load conditions.

4. The drive shall be designed to operate on an AC supply source that may contain line notching and up to 10% harmonic distortion to allow for operation of drives on an IEEE-519 dedicated system. An input isolation transformer shall not be required for protection from normal line transients. If line conditions dictate the use of a transformer, the K factor shall be 4.0 or less.

5. The drive shall include an MOV protection - phase to phase and phase to ground with provisions to remove ground connection if needed.

6. Protection shall be provided for AC line or DC bus over-voltage at 130% of maximum rated or under-voltage at 65% of minimum rated and input phase loss.

7. C. Features

1. The controller shall have features in accordance with the following:

   a. Digital keypad and display module shall provide parameter setting, adjustments and monitoring of control functions and faults. Display messages shall be in English.

   b. Serial communication port shall allow connecting to a programmable controller interface.

   c. Independent acceleration/deceleration settings providing separate adjustments to allow either setting to be adjusted from 0.0 seconds to 3600.0 seconds. A second set of remotely selectable Accel/Decel settings shall be accessible through digital inputs. Programming capability shall allow the user to produce Accel/Decel profiles with linear or “S-Curve” characteristics that provide changing Accel/Decel rates.

   d. Power loss feature shall allow logic ride through capability.

   e. Time delay automatic restart shall allow restart after resetable controller fault conditions with programmable attempts.
f. Coasting motor restart shall permit the controller to restart into a coasting motor without damage or tripping. The coasting motor restart feature shall allow switching from bypass mode to VFD mode while operating, without shutdown.

g. Control inputs and outputs shall be isolated.

h. An Economizer feature shall automatically reduces the output voltage when the drive is at a constant speed and partial load. The reduced voltage will minimize flux current in a lightly loaded motor and reduce kW usage. If the load increases, the drive shall automatically return to normal operation.

i. The drive shall have the capability for both internally mounted or externally mounted communications interface cards. Internal cards shall use drive power. Externally mounted cards shall be separately powered and connected to the drive via a cable. The following protocols must be available:

- DeviceNet
- EtherNet/IP
- ControlNet Coax
- ControlNet Fiber
- Remote I/O
- Profibus
- Modbus

j. Three adjustable set points shall be available to lock out continuous operation at frequencies, which may produce mechanical resonance. Set points shall have a bandwidth adjustable from 0Hz to 60Hz.

k. A user programmable restart function shall be provided to automatically restart the equipment after restoration of power after an outage. A maintained 2-wire start input shall be required for this function.

l. Start-Up Routines shall be included in the controller to allow the user to commission the drive quickly and accurately.

m. A sleep / wake mode feature shall provide the capability to use an analog input as a Start – Stop command. This shall be a separate input or the speed reference. A signal level below the “sleep” level shall act as a stop command and signal level above the “wake” level as a start command. Sleep / wake time and level shall be fully programmable.

n. The controller shall have protective functions in accordance with the following:

i. Input line side MOV (metal oxide varistor) transient protection.
ii. Electronic over-current trip instantaneous and inverse time overload protection.
iii. Over-temperature protection.
iv. Current limit trip protection.

v. Input line over and under voltage trip protection.

vi. Ground fault trip protection.

D. Output Power

1. The output voltage shall be adjustable from 0 to rated motor. The inverter section will produce a pulse width modulated (PWM) waveform using IGBTs.

2. Drives shall have software to limit the reflected wave due to long cable lengths to a maximum of 2.25 times the bus voltage or 1600V, whichever is less, up to cable lengths of 600ft (183m).

3. Standard on all ratings up to 200HP; Common Mode Capacitors with jumpers for removal when used on an ungrounded system or resistive grounded system. Internal Common Mode Cores on the drive output.

4. Drive shall have a programmable current limit from .1 amps to 150% of drive rated amps. Current limit shall be active for all drive states including accelerating, constant speed and decelerating. Both the source of the current limit value and the gain for responsiveness adjustment shall be programmable. The drive shall employ a PI regulation scheme with an adjustable gain for smooth transition in and out of current limit.

   a. Output current shall be available as follows:

      i. Normal Duty ratings:

      ii. 110% Overload capability for up to 1 minute

      iii. 150% Overload capability for up to 3 seconds

      iv. Heavy Duty ratings:

      v. 150% Overload capability for up to 1 minute

      vi. 200% Overload capability for up to 3 seconds

5. The drive shall provide UL Listed Class 10 motor overload protection to comply with N.E.C. Article 430. Overload protection shall be speed sensitive and adjustable. To accommodate a variety of motors with different speed range capabilities, the frequency at which the overload begins to derate shall be programmable. A minimum of two different levels of accumulated overload shall be signaled as alarm conditions. A parameter shall be available to directly read the level of accumulated overload.

E. Control/Logic

1. Operation of the drive with motor disconnected.

2. Controlled shut down with no component failure in the event of an output phase to phase or phase to ground short circuit and annunciation of any fault condition.

3. Thermal manager to sustain operation and provide full protection of the power devices by reducing PWM frequency and output speed as needed.

4. PWM carrier frequency shall have a default setting with capability for adjustments within a range of 2-10 kHz (Output current derating is permitted for operation with carrier frequencies set higher than default.)
5. Multiple programmable stop modes including: Ramp, Coast, Fast Brake, DC-Brake, Ramp-to-Hold and S-curve.

6. Multiple acceleration and deceleration rates.

7. All adjustments to be made with the door closed.

8. Adjustable output frequency up to 420 Hz.

9. The digital interface shall be used for all set-up, operation and adjustment settings. All adjustments shall be stored in nonvolatile memory (EEPROM). No potentiometer adjustments shall be required. The drive shall provide EEPROM memory for factory default values.

10. The last eight fault codes shall be stored in the fault buffer. In addition, information about the drive's condition at the time of the last fault such as operating frequency, output current, dc bus voltage and other status conditions shall be stored at the time of fault. Information shall be maintained in the event of a power loss. The last eight alarm codes shall also be stored for additional troubleshooting reference.

11. Drive shall be controlled by a remote PLC over network communication for normal operation. In addition manual controls shall be initiated by an emergency bypass float and relay control system as shown in Contract drawings.

F. Operator Interface

1. Interface to the drive shall be provided via a removable Human Interface Module (HIM) with integral display. This unit must have a minimum 7 line by 21-character backlit LCD display with graphics capability to display drive operating conditions, fault / alarm indications and programming information with full text support in multiple languages, including but not limited to English, German, French, Italian, Spanish, Portuguese and Dutch. The drive must also be capable of displaying all speed values in either Hertz or RPM.

2. The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), numeric keys for direct entry and an ALT (alternate function) key to allow common drive programming or operating functions to be accessed directly.

3. Removable HIM shall be mounted to the exterior of the enclosure.

4. A Hand/Off/Auto switch with indicator light lamps and a Bypass/Test/Run switch with mode indicator lamps shall be provided. Switches and lamps shall be clearly labeled.

5. Enclosure exterior shall include a 24V mechanical hour meter connected to a drive output and record all motor run times including bypass mode.

G. Adjustments and I/O

1. REFERENCE SIGNALS:

   a. The drive shall be capable of the following speed reference signals:

      i. Digital MOP
      ii. Jog
iii. HIM (Program/Control panel)
iv. Analog Input signals (2)
v. Preset Speeds (7)
vi. Communication module commands

b. Analog input references shall be independently scaleable, both from the analog input side and from the speed reference side. A bi-polar analog signal (-10V to + 10V) may also be used to control direction.

c. The drive shall have over speed protection in the event that the output frequency exceeds the maximum reference by a specified amount.

d. All reference signals may have a trim signal applied to them for finer resolution and accuracy. Trim source and amount shall be programmable.

2. LOSS OF REFERENCE:

a. The drive shall be capable of sensing the following reference loss conditions;

i. Remote potentiometer wiper loss
ii. 2-10V DC signals below 1 volts (reset at 1.5 volts)
iii. 4-20ma signals below 2 ma (reset at 3 mA)

b. In the event of loss of an analog input reference signal, the drive shall be programmable to act in the following way:

i. Fault the drive
ii. Alarm and maintain last reference
iii. Alarm and go to preset speed
iv. Alarm and go to minimum speed
v. Alarm and go to maximum speed
vi. Alarm and maintain last output frequency

c. Signal loss detection must be available regardless of the function of the analog input

2.04 OUTPUT FILTER

A. GENERAL:

1. An output filter or motor terminator circuit shall be provided to prevent overstressing the motor insulation system. An output sine wave filter, dv/dt filter or motor terminator circuit shall be included for each variable frequency drive, whenever the cable length between the motor and variable frequency drive exceeds the motor voltage withstand capability.

2. Output terminator circuits shall be provided as the first choice except in extreme cases of motor lead length or inaccessibility of the motor such as in a down-hole well pump motor. In all other cases, use of filter should be based upon the recommendations of the variable frequency drive and motor manufacturers, whenever the actual voltage peaks at the motor terminals exceed the NEMA-MG1 limits.
B. FEATURES:

1. The filter shall be three phase, 600 volt class motor-protecting type consisting of suitable values of inductance, capacitance and resistance to form a damped, low pass filter.

2. The filter shall be a low-loss type specifically designed to reduce the voltage waveform \(\frac{dV}{dT}\). The filter shall allow cable lengths at minimum exceeding the actual application distances with a waveform resulting in voltage spikes at the motor terminal which are within the NEMA-MG1-Part 31 voltage stress levels.

3. The filter shall be suitable for mounting within the variable frequency drive enclosure.

4. When Terminators are used they shall be mounted within 5 feet of the motor.

2.05 CONTROLS

A. GENERAL:

1. Each VFD shall include all relays, switches, fuses, indicating lights and other components required for a complete functional system.

2. Each VFD shall include a suitably sized and protected isolating control power transformer.

3. Each VFD shall include status indicators, controller and system fault condition displays and operating controls installed on the front door of the enclosure.

B. CONTROL / PILOT DEVICES:

1. Relays shall be standard, latching type and pneumatic or solid state time delay type. Relays shall be provided with the number of contacts as required.

2. Pilot devices shall be heavy duty type.

C. OPERATION:

1. Controls for each VFD shall consist of all devices as necessary for the following operation:

2. Stop/Start and Speed Control: The stop/start and speed control shall respond to a drive mounted selector switch. With the switch in position, "AUTO", stop/start and speed control shall be based upon a stop/start contact and Ethernet speed signal from the PLC. With the switch in position, "HAND," stop/start control shall be based upon remote stop/start pushbuttons located on the drive panel. Speed control when in position, "LOCAL", shall be based upon drive mounted speed potentiometer.

3. Drive Disable Control: The Drive Disable control shall respond to a remote stop pushbutton located adjacent to the driven equipment. When activated, the driven equipment shall stop output to motor immediately in all operating modes and allow motor to coast.

4. Motor Over-Temperature Shutdown: The motor over-temperature control shall respond to a remote contact which activates on motor over-temperature. When
over-temperature is detected, the driven equipment shall produce a fault code and coast to a stop.

D. AUXILIARY FEATURES:

1. Each variable frequency drive shall be provided with the following auxiliary features:
   
a. Status Indicators: Status indicators shall include separate pilot lights for indication of motor run, and bypass mode.
   
b. Contact Outputs: Contact outputs shall include separate dry contacts for remote indication of motor run and drive fault or alarm condition.
   
c. Speed Output: Speed output shall include a 4 to 20 mA DC signal for remote indication of motor speed.
   
d. Stopping and displaying a fault

2. The drive shall be provided with an Ethernet communications port for default operation and control by station PLC.

3. The control panel shall provide a real time clock for time stamping events and fault conditions.

2.06 SPECIFIED DRIVE MODEL

A. Drive will accept three phase 480VAC input and output to a 3-phase 20Hp motor in Heavy Duty mode.

B. Allen Bradley Powerflex 700; or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install as per the contract drawings, manufacturers’ recommendations, and in accordance with all applicable code and ordinance.

3.02 START-UP

A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Owner and a copy to be kept on file at the service center.

B. Manufacturer’s certified personnel shall program the VFDs to match the motor load characteristics to integrate with other systems.

3.03 SUPPORT

A. Factory trained application engineering and service personnel that are thoroughly familiar with the Drive products offered shall be locally available at both the specifying and installation locations.

3.04 WARRANTY
A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll free phone number.

PART 4 - SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for this, and all items, shall be included within the total lump sum price of the Electrical, Wiring, Panels, Level Controls and Scada as shown on the bid form. Progress payments will be made based on the progress complete percentage of the schedule of values, as approved by the Engineer.

END OF SECTION
SECTION 16440– PANELBOARDS

PART 1   GENERAL

1.01 WORK INCLUDES

A. Provide all equipment shown on the drawings.

B. Provide complete assemblies with main breakers, distribution circuit breakers, sub-distribution panels, motor controls, starters relays, time clocks, switches, controls, etc., in a complete assembly as shown on drawings and outlined in specifications for motor control center assemblies.

C. Provide circuit breakers with sufficient interrupting capacity per the utility company service available fault current estimate.

1.02 REFERENCES

A. Study the contract drawings carefully, including elevation views as well as the one-line drawing.

PART 2   PRODUCTS

2.01 GENERAL PANEL REQUIREMENTS

A. Main electrical control panels shall be housed in a NEMA 1 enclosure of the size shown on the contract drawings. Panels shall, in general, be made up of manufacturer’s standard depth modules, not to exceed 20”, as shown on plans. Deviations may be permitted if uniform panel appearance is presented. All sections of modules including switchgear sections shall be perfectly aligned to look like one complete unit when assembled. Wiring terminal Class II Type C. Panels shall be designed, manufactured, assembled at the factory, and tested in accordance with the latest applicable standard of NEMA, ATEE, and ASA. The vertical sections and the individual units shall bear a UL label as evidence of compliance with UL Standard 845. Service equipment shall be UL labeled as suitable for the application.

B. Laminated nameplates shall indicate all controller operations and the panel shall be primed and painted with Dupont Dulux Alkyd Enamel or approved paint, with custom color. The back panels of draw out units shall be painted white enamel. All painting shall be in a first class craftsmanship manner. Paint finish shall be smooth and free from rough surfaces such as sand, dust and scratches. Custom color selection shall be by Engineer.

C. Panels arriving to job site shall be inspected for scratches, dents, etc. Any panel found unacceptable shall be returned to panel manufacturer for repainting at panel suppliers and manufacturer's expense.

D. See electrical drawings for motor control centers layouts and positioning of pilot and other devices. Provide door latches and key locks on full-section doors and others as may be shown on the drawings.

2.02 PANEL LIGHTING AND DISTRIBUTION BOARDS

A. Panelboards shall have as a minimum the number of branch spaces as listed on the riser diagram or panel schedules listed in this Division or on the diagrams.
B. Panelboards shall be an integral part of the main distribution and MCC unless remote mounted, where they shall be of conventional, wall mounted type. Any mounted outdoors shall be of type and design so as to be protected in that location.

C. Electrical characteristics shall be as listed on Riser Diagram or panel schedule listed in this Division.

D. All breakers shall be bolt in quick-make, quick-break, ambient compensating with a minimum of 22,000 amp interrupting capacity, and as required by code and the interrupting current requirements of the source. Type GHB General Electric, Square D, Westinghouse, Siemens, Cutler Hammer, or ITE.

E. Identification cards in panel doors shall be machine printed to identify all circuits. Spare blank cards shall also be provided in each door. Panels shall be fitted with flush lift latches and shall have hinges on the side rather than on the top. Outdoor enclosures shall have full piano hinges and shall be gasketed.

F. Ground fault circuit interrupters (GFCI) designed to protect against hazards caused by ground faults shall be compatible with other adjacent breakers in the panel. GFCI shall be used where required by code or where indicated on drawings and in panel schedules. GFCI breakers shall have the same characteristics as breakers described above.

G. Door and key lock. Panels inside lockable buildings shall not require locking doors. All other panels shall require locking doors, keyed alike with the MCC doors.

H. Master keying for cabinet door locks.

I. Engraved nameplate for panelboard.

J. Color to match main distribution panel or adjacent walls. Consult with Engineer.

**PART 3 EXECUTION**

3.01 SUBMITTAL

A. Panelboards shall be ordered which comply with both the one-line drawings and the elevation drawings depicting section assignments. Contractor shall provide a detailed submittal to the Engineer and obtain Engineer’s approval of the proposed motor control centers before ordering them. Submittal shall be included in the post-bid submittal package discussed elsewhere in these documents.

3.02 CONDUIT ACCESS

A. Provide proper conduit terminations at locations shown in the drawings or as required for workmanlike routing of conduit runs.

**PART 4 SPECIAL PROVISIONS**

4.01 MEASUREMENT AND PAYMENT

A. Payment for the panelboards and other work in this section shall be included as a portion of the lump sum or unit price for the items requiring panelboards within the project as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

**END OF SECTION**
SECTION 16478 – TRANSIENT VOLTAGE SURGE SUPPRESSOR

PART 1  GENERAL

1.01 DESCRIPTION OF WORK

A. The work required under this division shall include all materials, labor and auxiliaries required to and install one surge suppressor for the protection of building electrical and electronic systems from the effects of line and electromagnetic induced transient voltage surges and coupled lightning discharged transients as indicated on drawings or as specified in this section.

1.02 REFERENCE SECTIONS


B. ANSI/IEEE C62.41 – Recommended Practice for Sure Voltages in Low Voltage AC Power Circuits

1.03 SUBMITTALS

A. Submit shop drawings under provisions of SECTION 16050, and meeting the requirements of Section 01300.

B. Submit product data under the provisions of SECTION 16050.

C. Submit product data indicating standard model design tests and options.

D. Submit manufacturer's installation instructions under provisions of SECTION 16050.

1.04 QUALIFICATIONS

A. Equipment certification: Items shall be "Listed" by Underwriters Laboratories, Inc. and shall exhibit the UL Listing Mark for the category "Transient Voltage Surge Suppressors" or TVSS. UL Listing Card under category TVSS shall be provided to confirm compliance to UL1449 Second Edition Standard and assigned Suppressed Voltage Ratings.

B. Surge Protective Devices shall be installed and located in accordance with the requirements of all applicable National Fire Protection Association (NFPA) codes. The device shall be installed on the load-side of the main service disconnect per the scope of UL 1449 Standard for Safety for Transient Voltage Surge Suppressors.

C. Manufacture shall have a minimum of ten (10) years of experience in the manufacture and service of TVSS devices.

PART 2  PRODUCTS

2.01 TVSS Surge Protector

A. General: Provide service panel TVSS devices as shown on the drawings in conformance with the following specification. All surge devices shall be built in accordance with the latest revised IEEE, ANSI and NEMA standards.

B. Temperature rating: Shall be designed to have an operating temperature from -10 to +60 degrees C.
C. Enclosure: Shall be NEMA 12 for indoor, or 4X for outdoor rated.

D. Operating Voltage: Surge Protectors shall be designed for the specific type and voltage of the electrical service as indicated in drawings, and provide suppression for L-L, L-G, L-N of 1000 volts and shall be configured to operate at 277/480 Volt 3-phase Wye.

E. Short circuit rating: 150kA RMS symmetrical amps.

F. Testing: Shall be UL 1449 listed.

G. Diagnostics: Shall include LED lights to indicate operation and alarm. Include dry contact for monitoring.

H. Manufacturer: Shall be as made by Siemens, Rockwell Automation, Meter Treater, GE, Cutler Hammer, Square D; or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions. One single device shall be installed.

B. Install in position as shown in Contract Drawings, connected to the top of the primary service panel, where the transfer switch connection is made.

C. Properly ground connection to conduct surges from the main bus. Wire leads should be short as possible and avoiding tight bends.

D. Installation of this device shall not be construed to eliminate other secondary surge suppression, such as that providing by other equipment, in the control panel, or provided by motor drives.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for the TVSS and other work in this section shall be included as a portion of the lump sum or unit price for the items requiring TVSS within the project as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 16490 – COMPONENTS AND ACCESSORIES

PART 1    GENERAL

1.01 WORK INCLUDES

A. Provide the following components and accessories.

PART 2    PRODUCTS

2.01 BREAKER LOCKOUT STATION

A. Provide an OSHA approved circuit breaker lockout station, wall mounted within view of the panelboards. The station shall contain a selection of lockout hasps and color coded padlocks with keys. Each kit shall contain devices for locking out actuator handles as well as individual panelboard circuit breakers. Approved manufacturers are Brady, Master Lock, and Prinzing, or equal.

2.02 EQUIPMENT ID TAGS

A. Provide equipment ID tags, both laminated plastic and embossed stainless steel, as described in the tag schedules on the electrical drawings and as described in these specifications (especially the Enclosed Controllers specifications).

2.03 SPARES

A. Contractor shall furnish various spare parts as required in the drawings and specifications. For example, Contractor shall furnish:

1. One of each of the different types of floats used in the project.
2. Six spares of each of the different types of fuses

PART 3    EXECUTION

3.01 INSTALLATION

A. Install per manufacturer’s recommendations and instructions.

B. Installation shall be performed in the arrangement and position as shown on the drawings.

PART 4    SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for the components and accessories and other work in this section shall be included as a portion of the lump sum or unit price for the items requiring component and accessories within the project as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 16500 – LIGHTING

PART 1 GENERAL

1.01 DESCRIPTION OF WORK
A. The work consists of providing a complete lighting system as specified herein and shown on the drawings.

1.02 SUBMITTALS
A. Fixture construction details, photometric data, and ballast type shall be supplied as part of the submittal procedure.

1.03 QUALITY ASSURANCE
A. The Contractor shall test all lighting installations and demonstrate satisfactory operation of switching controls upon completion of the installation. The Contractor shall replace all defective lamps and/or ballasts prior to occupancy by the Owner. All fixtures shall be cleaned and visible labels removed.
B. Fluorescent lamps and ballast shall be designed to work together as a system. Shall be OSRAM-Sylvania or approved equal.

1.04 RELATED DOCUMENTS
A. Drawings and specifications included in the project documents
B. Division 16 – Electrical
C. Section 16050 and 16100

PART 2 PRODUCTS

2.01 FIXTURES
A. The Contractor shall be responsible for the complete equipment of all fixture types called for. All standard fixtures shall be approved by UL and shall have UL inspecting labels attached thereto. Fixtures shall be grounded in accordance with the NEC.

2.02 LIGHTING

A. Interior Control Building – 2 and 3 lamp, T-8, surface mount 4 wrap fixtures
   1. Rolled pre-painted stamped steel.
   2. Steel endplates
   3. Clear full thickness virgin acrylic prismatic lens.
   4. Matte white finish
   5. 2 lamp F32 T-8 class P electronic ballast
   6. Universal Voltage
   7. Metalux WS Series; or approved equal
B. Garage Lights – 2 lamp, T-8, surface mount 4 foot fluorescent fixtures
1. Die formed cold rolled pre-painted steel
2. Baked white enamel finish
3. 2 or 4-lamp electronic program start ballast
4. Universal Voltage
5. Narrow 4 ¼” housing
6. Cooper Allpro series; or approved equal

C. Recessed Can Lighting – Universal Can light fixture
1. 6” diameter for 6 ½” ceiling cutout
2. Airtight
3. Integral J-box w/ Romex knockouts
4. UL listed for damp locations
5. Adjustable hanger bars
6. Snap in socket base for trim installation
7. Frosted glass lens in damp locations
8. Trim to drawing notations w PAR 30 light fixture
9. Econolight ET6300 series; or approved equal

D. Outdoor Wall Sconce Lighting--LED
1. Die Cast aluminum base w/ bronze powdercoat
2. Screw in polycarbonate lens
3. UL listed for damp locations
4. Cree LEDs inside
5. 50,000 hours maintenance free operation
6. 120V operations
7. Econolight E-WG1L21NZP series; or approved equal

E. Wall Sconce Lighting–T5 wall mounted fluorescent lighting
1. Natural aluminum base w/ 1/8” matte white extruded aluminum acrylic panel
2. Decorated luminous sconce
3. UL listed for damp locations
4. 120V electronic HPF ballast for 2-14W T5 lamps
5. Shaper 605 series; or approved equal

F. Exit Lighting – LED w/ Integral emergency lighting
1. Injection molded thermoplastic
2. White Finish
3. Red Exit lettering
4. 120/277V power
5. Integral lead cadmium battery
6. Dual 5.4W 6V Incandescent lighting lamps
7. Long life LED AC lamps
8. Solid state battery charger
9. Sure Lite AP series; or approved equal
G. 2-Lamp fluorescent fixtures, Fiberglass reinforced polyester housing vaportight w/ T-8 ballast.

1. Ballasts shall be 277V CBM/ETL Class “P” certified
2. UL CL listed for wet locations.
3. Surface Mount
4. Stainless steel latches
5. Internal prismatic lens w/ 15% DR high impact additive.

H. Single lamp perimeter wall packs. Polycarbonate with cast aluminum back housing.

1. Available with motion or photocontrol, configuration as shown on drawing sheets.
2. Surface mounted
3. UL CL listed for wet locations
4. LED 40w
5. Bronze color
6. Cooper WP Wal-Pak Series, or equal

I. Area lamps: Die cast aluminum frame, housing and door LED outdoor fixture with 2 7 lightbar LED lamps with high-efficiency optics

1. UL CL listed for wet locations
2. Isolated driver components
3. Passive cooling construction for 40C ambient operation
4. Stainless steel fasteners and hinges
5. 120V-277V 60Hz operation at 101 watts
6. Designed to withstand 10kV of transient line surge
7. 50,000 hour life with >70% lumen maintenance
8. IP66 enclosure rating
9. Integral cast 6” arm w/ bolt guides for positioning on lighting pole
10. Black color
11. 5 year warranty
12. Dual Fixture poles: Streetworks AVM 4 Bar C04 120V; or approved equal.

J. Lighting Pole as manufactured by Cooper, Lithonia, Rudd; or approved equal.
   1. 6"x6" Round aluminum
   2. Black finish
   3. Integral handhole for wiring, stainless hardware
   4. Concrete anchors as approved by manufacturer
   5. Provide stainless hardware to attach area light fixtures

2.03 LAMPS

A. T7 lamps shall be bi-pin type, Tri-Phosphor with Color Rendering Index (CRI) exceeding 82, Correlated Color Temperature (CCT) of 3500 Kelvin with a minimum initial lumen output of 2850 lumens when operated on a reference ballast with a ballast factor of 1.0, or as indicated in the Fixture Schedule.

B. T-8 Super System: lamps shall be bi-pin type, Tri-Phosphor with Color Rendering Index (CRI) exceeding 85, Correlated Color Temperature (CCT) of 3500 Kelvin with a minimum initial lumen output of not less than 3100 lumens when operated on a reference ballast with a ballast factor of 1.0. Rated lamp life of not less than 30,000 hours when operated at 3 hours per start. Osram Sylvania XPS, Philips Advantage or General Electric. A ballast compatible with the lamp as a system is required as specified in ballast section.

C. T-5 lamps shall be bi-pin type, Tri-Phosphor with Color Rendering Index (CRI) exceeding 82, Correlated Color Temperature (CCT) of 3500 Kelvin or as indicated in the Fixture Schedule.

D. T-12 lamps shall not be used.

E. Provide low mercury (maximum 6 milligrams for standard 48 inch lamp) TCLP compliant (Toxicity Characteristic Leaching Procedure) lamps for all luminaires.

F. Compact Fluorescent:
   1. Of wattage and configuration indicated in Fixture Schedule, Tri-Phosphor with Color Rendering Index (CRI) exceeding 81, Correlated Color Temperature (CCT) of 3500 Kelvin or as indicated in the Fixture Schedule.
   2. Amalgam technology to be used wherever at least one manufacturer supplies the specified lamp with that technology.
   3. Lamps shall be single ended four-pin plug-in base where available.
   4. Self ballasted lamps shall not be provided unless specifically indicated in the Fixture Schedule.
   5. All fluorescent lamps shall be of the same manufacturer and phosphor coating unless specifically identified in the Fixture Schedule.

G. Metal Halide:
1. Ceramic arc tube type:
   a. Of wattage, configuration, and base style indicated in Fixture Schedule, ceramic arc tube type with Color Rendering Index (CRI) exceeding 80, Correlated Color Temperature (CCT) of 3000 Kelvin or as indicated in the Fixture Schedule.
   b. Maximum rated +/- 200 Kelvin color shift over rated lamp life.
   c. Universal burn rated.
   d. Lamps used in open luminaires shall be rated for such use.

2. Quartz arc tube type:
   a. Of wattage, configuration, and base style indicated in Fixture Schedule, Color Rendering Index (CRI) exceeding 64, Correlated Color Temperature (CCT) of 4000 Kelvin or as indicated in the Fixture Schedule.
   b. Maximum rated +/- 600 Kelvin color shift over rated lamp life.
   c. Pulse-start type wherever at least one manufacturer supplies the specified lamp with that technology or as indicated in the Fixture Schedule. Provide pulse-start type where lamp orientation is compatible with lamp manufacturer's recommendations.
   d. Lamps used in open luminaires shall be rated for such use.

3.02 ACCESSORIES
   A. Fixtures shall be furnished complete with all lenses, trims, hangers, nipples and extensions necessary for a complete installation. All light diffusing media shall be free of scratches or cracks. In general, diffusers shall be of acrylic material unless otherwise noted.

PART 4 EXECUTION
4.02 INSTALLATION
   A. Supports
      1. All supports for fixtures shall be furnished. All stem lengths shall be adjusted to meet conditions. Mounting heights to bottom of fixtures are given as accurately as possible and shall be adjusted to conform to job conditions.
      2. Clean all fixture lenses prior to final acceptance.
   
   B. Grounding
      1. Lighting systems shall be securely grounded. For rigid conduit, a threaded hub or double locknut and bushing connection shall be considered adequate. For systems employing flexible conduit feeds, a green insulated No.12 AWG solid wire shall be run with the phase conductors, and bonded to the box and fixture at each end of the flexible conduit. The ground connection shall be accomplished by means of cadmium plated round head machine screws, lockwasher and nut.
C. Coordination

1. The Contractor shall provide adequate fixture attachment to ceiling members in accordance with NEC. The Contractor shall inspect the mechanical plans and the actual site to verify that no interferences occur with diffusers, grilles or duct work or piping.

PART 5 SPECIAL PROVISIONS

5.02 MEASUREMENT AND PAYMENT

A. Payment for the lighting and other work in this section shall be included as a portion of the lump sum or unit price for the items requiring lighting within the project as stated in the Bid Form. No separate measurement or payment for these quantities will occur.

END OF SECTION
SECTION 16700 - COMMUNICATIONS

PART 1  GENERAL

1.01  CONTRACT CONDITIONS

A. Work of this section is bound by the General Conditions, Supplementary Conditions and Division 1 bound herewith in addition to this Specification and accompanying Drawings.

B. Note: These specifications relate to the Control Building only. Coordinate and comply with the Wastewater Treatment Plant Drawings and Specifications where the building phases overlap or interface.

1.02  RELATED WORK SPECIFIED ELSEWHERE

A. Basic Materials and methods, Section 16100.

1.03  GENERAL

A. Systems included under this Section:

B. Conduits and Pull String for future systems.

C. All products of section to be UL listed or approved by a comparable national testing agency.

D. All work to comply with NFPA standards, National Electrical Code, Uniform Building Code and Uniform Fire Code.

PART 2  PRODUCTS

2.01  CONDUIT AND BOXES

A. Same materials as for power wiring.

B. Refer to Section 16050.

2.02  TELEPHONE/COMPUTER

A. Telephone/Computer stations in locations shown on drawings. Coordinate with Owner provided system installer. Do not allow cover until system installed.

2.03  CABLE TELEVISION

A. Locations as indicated on drawings.

PART 3  EXECUTION

3.01  GENERAL

A. Review specific requirements of various Owner supplied systems with Architect.

B. Terminate conduits in wall boxes (minimum 4" x 4" x 2", unless noted) at various outlet locations.
C. Cap empty conduits terminating outside box or panel.

D. Label each conduit at ends for system and location.

E. Provide pull wire with all empty conduits.

3.02 TELEPHONE/COMPUTER

A. Provide underground conduits for telephone service.

B. Wall Telephone Outlets: 4" square box with single gang plaster ring and conduit to accessible ceiling space.

C. Telephone and computer circuits will be run by Owner provided installer. Installer to provide cover plates.

D. Contractor to provide ¾" x 4’ x 4’ sheet of plywood in electrical room for telephone equipment mounting.

E. Telephones to be purchased by Owner.

3.03 CABLE TELEVISION SYSTEMS

A. Provide underground cable television service to location in garage.

B. Provide boxes and wiring to outlet locations. Circuitry to be installed by Contractor.

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SECTION 17100 – PUMP CONTROL PANEL

PART 1    GENERAL

1.01    WORK INCLUDES

A. This section specifies the provision and installation of a complete control panel for the lift station.

B. The system shall be a Rockwell Allen Bradley based system provided by the System Integrator for complete control of all pump station functions providing an operator level user interface and intuitive graphics screen. The system shall communicate by wireless to the existing City SCADA system.

C. Complete System. The Integrator shall provide a complete, functioning, finished control system, including ladder logic programs for the PLC, custom designed operator interface screens for the HMI, and a tags memory space in the PLC for transferring status and alarms. The finished work shall be operator-friendly and acceptable to the Engineer and Customer.

D. The Integrator shall be the City Integrator of Record, The Automation Group, Inc. www.tag-inc.us.

E. The Contractor shall, at minimum, procure programming services and the Control Panel from the Integrator. Instrumentation may be purchased from the Integrator.

F. Integration services shall be purchased by the Contractor. All charges by the Integrator shall be included in the bid price.

1.02    RELATED WORK:

A. Documents affecting work of this Section include, but are not necessarily limited to General Conditions, and sections in Division 1 of these Specifications.

1. Division 13000: Special Construction
2. Division 16000: Electrical

1.03    QUALITY ASSURANCE

A. Installation shall be performed by a Contractor approved by the web based SCADA system supplier, who is experienced with the installation of the SCADA equipment specified.

1.04    SUBMITTALS AND SUBSTITUTIONS

A. Comply with pertinent provisions of Section 01300.

B. The following product data shall be submitted in accordance with Section 01300 of these Specifications:
1. Shop Drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades;

2. Manufacturer’s recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work;

3. Test data required elsewhere in this Section.

4. Upon completion of this Portion of the Work, and as a condition of its acceptance, deliver to the Engineer three copies of an operation and maintenance manual compiled in accordance with the provisions of Section 01730 of these Specifications.

1.05 PRODUCT HANDLING

A. Comply with pertinent provisions of Division 16.

1.06 EQUIPMENT COMPATIBILITY

A. The Contractor shall be responsible for coordinating the instrumentation equipment, communication equipment, relays, sensors and other related equipment so that all elements are compatible and form a complete working system.

B. Shop drawing submittals shall include sufficient information regarding component compatibility to demonstrate compliance with this requirement.

PART 2 PRODUCTS

2.01 CONTROL PANEL

A. Provide a Nema 1 metal enclosure. Enclosure shall have locking doors and be mounted on raised feet or a raised concrete housekeeping pad.

B. A main feed circuit breaker 480V, as shown the on-line diagram. Breakers shall be minimum 22,000 AIC rated.

C. Feeder circuit breakers as shown in the one-line diagram. Breakers shall be minimum 22,000 AIC rated. Mount breakers to be accessible by untrained personnel

D. A supply transformer for internal power control circuits.

E. A UPS backup power supply capable of powering internal control circuitry for 5 minutes during brief power outages. The VFD’s shall have resetting circuitry for faults generated during power outages.

F. An Allen Bradley Comptactlogix PLC controller with standard digital and analog I/O. A minimum of 2 spare Analog inputs, 2 spare analog outputs, 8 spare digital inputs and 8 spare digital outputs shall be provided for future expansion.
G. A color Panelview Plus OIT touch display of minimum size of 8 inches. OIT shall have Ethernet TCP/IP connections to PLC.

H. A dedicated portion of the Control panel shall have isolated intrinsically safe relays for control wires which go to the wet well.

I. Two (2) VFD pump drives. VFD shall be Allen Bradley Powerflex series and conform to the VFD specification. Each drive shall have protection fuses or breakers, 5% line reactors, an HOA switch, hour meter, and run/fault front panel lighting. Other functions shall be permissible to be displayed on the OIT and over the City SCADA system. Additional space shall be allocated around the drives and fusing to upsize the motor by one (1) size in the future.

J. Two (2) across the line bypass contactors. Bypass circuit will have a panel mounted light indicated bypass mode and two position switch. Bypass contactors will be used if a VFD is out of service and will run automatically off the wet well floats.

K. A keyed switch on the front panel that bypasses the low level cutoff float for maintenance pump downs of the wet well. Provide the City with four (4) physical copies of the key.

L. Two (2) Lock out tag out disconnect switches for each pump mounted on the front of the panel.

M. A network radio and antenna matching the City’s existing SCADA system back to City Hall.

N. A network switch connecting the VFDs, OIT, PLC, radio and providing 2 spare connections for expansion and local programming.

O. A convenience receptacle inside the control panel.

P. Screw set terminals, wire busways, and spare terminals.

Q. Internal wiring. Wiring shall be sized per UL requirements and stamped by a Supervising Electrician and UL Stamp applied to the door.

R. Labeling on the exterior of the panel meeting UL requirements for safety labeling, labels for pumps and dials in white lettering on a black background.

S. A 24V power supply sufficient to power the control circuits, PLC and various I/O.

T. The control panel shall have an internal bay to store paper drawings and a store a flash USB drive that shall contain a current copy of the PLC and OIT program.

U. The following analog inputs:
   1. Wet well Level Transducer
   2. Magnetic Flow Meter
   3. The following analog outputs:
4. Pump 1 reference speed
5. Pump 2 reference speed

V. The following digital inputs:

1. Overflow Float
2. Hi Level Alarm Float
3. Pump Hi Level Off Float
4. Pump Low Level Off Float
5. Pump Low Low Alarm Float
6. Smoke Detector Alarm
7. Intrusion Switch
8. HOA Pump 1
9. HOA Pump 2
10. Pump 1 Bypass Contactor switch enabled (status, bypasses PLC)
11. Pump 2 Bypass Contactor switch enabled (status, bypasses PLC)
12. Pump 1 MiniCAS relay tripped (moisture and temp)
13. Pump 2 MiniCAS relay tripped (moisture and temp)
14. Pump 1 Bypass aux contact (status)
15. Pump 2 Bypass aux contact (status)
16. Power failure relay ATS in line power
17. ATS in generator power
18. Low propane tank level
19. Generator in Auto
20. Generator Common Alarm
21. Generator Major Alarm
22. Low low level switch bypass key enabled
23. UPS OK
24. VFD 1 locked out (disconnect contact)
25. VFD 2 locked out (disconnect contact)

W. The following network connections

1. VFD 1, for pump control and alarming
2. VFD 2, for pump control and alarming
3. Radio communication
4. OIT connection
5. PLC connection
6. Computer connection
7. Future connection

X. The following digital outputs

1. Pump 1 run light
2. Pump 2 run light
3. Pump 1 fault light
4. Pump 2 fault light
5. VFD 1 run
6. VFD 2 run
7. Pump 1 hour meter (meter also needs to record hours in bypass mode)
8. Pump 2 hour meter (meter also needs to record hours in bypass mode)

PART 3 EXECUTION

3.01 COORDINATION
A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.
B. Coordinate all installation with City of Veneta representative.

3.02 INSTALLATION
A. Install the work of this Section in strict accordance with the manufacturer’s recommendations and shop drawings as approved by the Engineer.
B. Upon completion of the installation, carefully inspect each component and verify that all items have been installed in their proper location, adequately anchored, and adjusted to achieve optimum operation.
C. If required, the contractor shall adjust the antenna placement or elevation to obtain consistent, stable operation of the system.
D. Provide certified startup for all components when available from the manufacturer to take advantage of any extended warranty programs.
E. Program and demonstrate the control panel in conformance with Division 17200.

3.03 SPARES
A. Deliver to the City spares of the following:

1. 2 of each type of indicator light.
2. 3 terminal blocks.
3. 2 of each type of relay.
4. 2 sets of shop drawings.
5. 2 of each type and rating of fuse.
6. 3 of each type of mechanical screw used in the control panel.
7. 1 of each type of switch

PART 4 SPECIAL PROVISIONS

1.01 MEASUREMENT AND PAYMENT
A. Payment for Components and Accessories and other work in this section shall be included as the unit price for the Electrical, Wiring, Panels and Controls as stated in the Bid Form for the Project. No separate measurement for these quantities will occur.

END OF SECTION
SECTION 17200 – CONTROL PANEL PROGRAMMING

PART 1  GENERAL

1.01  DESCRIPTION

A. Complete System. The Contractor shall provide a complete, functioning, finished control system, including radio based SCADA alarms, trending history, and operator level access control. The finished work shall be operator-friendly and acceptable to the Engineer and Customer.

1.02  WORK INCLUDED

A. Program the PLC.
B. Setup SCADA screens and alarms.
C. Adjust and setup the radio.
D. Program the OIT.
E. Set up the (1) flowmeter.
F. Connect and scale the transducers.
G. Adjust float levels.
H. Set alarm conditions

1.03  RELATED DOCUMENTS

A. Section 17100 Control Panel

PART 2  PRODUCTS

2.01  PURCHASED MATERIALS

A. The Contractor shall supply all cables, manuals, etc., necessary for the completion of the work.
B. The Integrator shall maintain software licenses required to program the PLC and OIT functions.

PART 3  EXECUTION

3.01  DELIVERED DOCUMENTATION

A. Provide (3) binders, each containing the following:
1. USB w/ copies of all the files developed under this section
2. Control Manual, describing how to use the controls and a listing of alarm messages and their meanings w/ troubleshooting tips.
3. OIT screen shots and configuration listings.

3.02 PUMP STATION OPERATIONS

A. Integrator shall set up pumping operations as a duplex station with one pump providing full flow capacity.
   1. In the event of a pump fault the second pump shall automatically come online and become the lead pump.
   2. Pump shall operate to balance run times.

B. The flowmeter shall report instantaneous and total flows over time. The flow meter shall be used to set VFD speeds. VFD speeds shall not be based upon Hz as the pump impellers wear over time.
   1. The pump shall begin pumping at an initial velocity at start of 3.5 feet per second to flush the forcemain and maintain this velocity for 2 minutes. Thereafter the pumps shall never slow to less than 2 feet per second as a minimum velocity.

C. The wetwell level shall be controlled by use of the submersible level transducer. The transducer will have pump start and pump stop levels adjustable by the operator.
   1. Wetwell levels shall be controlled by a PID loop to minimize pump start/stops. As the level of the wetwell increases the pump speed will also increase to maximum speed. Likewise, as the level drops the pump speed will decrease until it reaches minimum speed.
   2. The wetwell stop level shall be automatically varied slightly in software to randomize the scum level line created.
   3. The operator shall have control over high high alarms, overflow alarms, and low low alarm levels. The Integrator will work with the Engineer to set up the initial levels.

D. The backup float system shall have permanently affixed floats. There will be several alarms points. These alarm points shall be slightly above or below the points set in the OIT of the transducer.
   1. Overflow float will alarm back to the SCADA that an overflow event is imminent or has occurred. The Software shall time how long the event occurred. It will also trigger the bypass contactor on Pump 2.
2. The high high float will sound a warning. In addition, the high high float will trigger the bypass contactors and automatically run the pump station until the user intervenes and resets the pump station to PLC control. It will initialize pump 1.

3. The high float will serve as a backup to the pump shutoff level on the transducer. It will also serve as the pump start float when in bypass contactor mode for Pump 1.

4. The low float will serve as a backup to the pump shutoff level on the transducer. It will also serve as the pump shutoff float when in bypass contactor mode for Pump 1 and Pump 2.

5. The low low float will serve as an emergency stop float for the pump station. It will prevent both pumps from running in any mode. The only way for the pumps to operate with the low low float triggered is to have the bypass key turned on the control panel by the operator. The OIT and SCADA will alert that the key is in the bypass condition.

E. There shall be a weekly flush mode where the wetwell is allowed to fill over the high level but below the high high alarm. The day and duration shall be adjustable by the operator and allow the pump to run at flushing velocity (3.5 feet per second) until the wetwell shutoff is reached.

F. The system shall alert on no flow condition using either the flowmeter or check valve limit switches when the pumps are running but there is no flow.

G. The transfer switch shall control the generator system, but the control panel shall alarm and indicate status of the generator and ATS.

H. Smoke alarms and door intrusion shall alarm over the SCADA.

3.03 OIT DISPLAY

A. The OIT shall have an intuitive interface showing visual depictions of the pump station including but not limited to:

1. The pumps.

2. Wetwell and water level in the wetwell

3. Approximation of the discharge piping showing check valves and flowmeter.

4. Floats and their status.

B. Integrator shall use color and motion to make it obvious to operator which functions of the pump station are active and which are inactive. Green shall be used for items properly operating, amber or yellow for notifications, and red for items in failure or critical alarm.
C. Trending screens shall be shown for wetwell levels, pump hours, VFD speeds, and the flowmeter. The trending screen shall be scrollable to go back several weeks.

D. Alarms shall be acknowledgeable and have a time and date history to show all alarms both acknowledged and unacknowledged.

E. Integrator shall work with City to provide user level adjustment of items that can be manually input or overridden on the OIT, such as VFD speeds, pump lead/lag controls, wetwell levels, alarm time delays, flushing timers, and user level access.

F. The OIT functions shall be visible on the SCADA system.

3.04 COMPLETE SYSTEM

A. This Division contains a rudimentary description of the pump station operations. The Contractor shall be responsible for designing a complete software system that is documented, operator-friendly and acceptable to the Customer and Engineer.

PART 4 SPECIAL PROVISIONS

4.01 MEASUREMENT AND PAYMENT

A. Payment for Control Panel Programming shall be included as the unit price for the Scada Controls as stated on the bid form for the project. No additional payment will be made for this item.

END OF SECTION
Report of
Limited Geotechnical Investigation
Jack Kelley Drive Lift Station
Jack Kelley Drive & 8th Street
Veneta, Oregon

CGT Project Number G1704699

Prepared for

Civil West Engineering Services, Inc.
c/o: Ms. Manda Catterlin
945 Geary Street
Albany, Oregon 97321

January 11, 2018
January 11, 2018

Civil West Engineering Services, Inc.
c/o: Ms. Manda Catterlin
945 Geary Street
Albany, Oregon 97321

Report of
Limited Geotechnical Investigation
Jack Kelley Drive Lift Station
Jack Kelley Drive & 8th Street
Veneta, Oregon

CGT Project Number G1704699

Dear Ms. Catterlin:

Carlson Geotechnical (CGT), a division of Carlson Testing, Inc. (CTI), is pleased to submit this report summarizing our geotechnical investigation for the proposed Jack Kelley Drive Lift Station project. The project site is located at the southeast corner of the intersection of Jack Kelley Drive and 8th Street in Veneta, Oregon. We performed our work in general accordance with CGT Proposal GP7731, dated September 11, 2013. Written authorization for our services was provided on September 14, 2017. A draft version of this report was issued on November 30, 2017, to allow for the project team to provide comments to incorporate into the final report. With the exception of a slight modification to our original Site Plan (Figure 2) and minor changes to the dimensions of the control building, no other comments were provided.

We appreciate the opportunity to work with you on this project. Please contact us at 503.601.8250 if you have any questions regarding this report.

Respectfully Submitted,

[Signature]
Jeffrey P. Quinn, P.E.
Geotechnical Engineer
jquinn@carlsontesting.com

[Signature]
Brad M. Wilcox, P.E., G.E.
Principal Geotechnical Engineer
bwilcox@carlsontesting.com

Carlson Geotechnical • 89970 Highway 99N, Eugene, Oregon 97402
1.0 INTRODUCTION

Carlson Geotechnical (CGT), a division of Carlson Testing, Inc. (CTI), is pleased to submit this report summarizing our limited geotechnical investigation for the proposed Jack Kelley Drive Lift Station project. The project site is located at the southeast corner of the intersection of Jack Kelley Drive and 8th Street in Veneta, Oregon, as shown on the attached Figure 1.

1.1 Project Description

CGT developed an understanding of the proposed project based on our correspondence and review of preliminary project plans provided by Civil West Engineering Services, Inc. We understand the project will include:

- Installation of a wet well structure at the central portion of the station (approximate STA 42+00). The wet well will be installed approximately 220 feet south of Jack Kelley Drive. The wet well will be circular in cross-sectional area, 8-feet diameter (inner), and installed to bear at a depth of about 25 feet below existing site grades. Although no structural information has been provided, we anticipate the wet well will consist of cast-in-place concrete construction. Design of the wet well structure, as well as selection of the method for installation, will rest with others.

- Construction of a new, one-story, electrical/maintenance building at the lift station. The building will measure 12 feet by 8¾ feet and incorporate a slab-on-grade floor. No below-grade levels (basements) are anticipated for this building. Although no structural information has been provided, we assume maximum column, continuous wall, and uniform floor slab loads will be on the order of 30 kips, 2 kips per lineal foot (klf), and 250 pounds per square foot (psf), respectively.

- Installation of asphalt-paved driveway and appurtenant utilities at the lift station.

- Although no grading plans have been provided, we understand permanent grade changes at the site will be minimal, with cuts and fills limited to less than 3 feet in depth.

1.2 Scope of Work

The purpose of our work was to explore subsurface conditions at the site in order to provide limited geotechnical engineering recommendations for design and construction of the proposed lift station. Our services was considered “limited” as this assignment did not include an evaluation of seismic/geologic hazards at the site. Our scope of work included the following:

- Contact the Oregon Utilities Notification Center to mark the locations of public utilities at the site within a 30-foot radius of our planned explorations. CGT also subcontracted a utility locating company to mark the locations of public and private utilities within a 30-foot radius of our planned explorations.

- Explore subsurface conditions at the site by advancing three drilled borings to depths up to about 41½ feet below ground surface (bgs) using a track-mounted drill rig provided and operated by our subcontractor. Details of the subsurface investigation are presented in Appendix A.

• **Limited Geotechnical Report**: Prepare a Limited Geotechnical Report that includes the following:
  
  o **Site Vicinity Map & Site Plan**: A site vicinity map and site plan showing the approximate location of the explorations relative to existing site features.
  
  o **Exploration Logs**: Logs of the borings, including depths of measured groundwater, results of laboratory testing performed on selected soil samples.
  
  o **Technical Narrative**: A technical narrative describing the completed field investigation and descriptions of the subsurface materials encountered.
  
  o **Site Preparation & Earthwork**: Geotechnical recommendations for site preparation, stripping depths, wet/dry weather earthwork, fill type for imported materials, re-use of on-site soils as structural fill, compaction criteria, temporary excavations, dewatering considerations, and general grading and drainage considerations.
  
  o **Wet Well Structure [Design Parameters]**: The following wet well design parameters:
    - Lateral earth pressures above the groundwater table;
    - Lateral earth pressures below the groundwater table;
    - Lateral surcharge loading;
    - Buoyancy / uplift pressures; and
    - Foundation support parameters (allowable bearing capacity & subgrade modulus).
  
  o **Wet Well Structure (Construction Considerations)**: Geotechnical recommendations related to installation practices for wet well structures.
  
  o **Building Shallow Foundations**: Geotechnical engineering recommendations for design and construction of shallow foundations.
  
  o **Building Floor Slabs**: Geotechnical engineering recommendations for design and construction of concrete floor slabs.
  
  o **Pavements**: Geotechnical engineering recommendations for pavement subgrade preparation.

2.0 SITE DESCRIPTION

2.1 Site Geology

Based on available geologic mapping\(^1\) of the area, the site is in an area underlain by alluvium (Holocene) and weathered terrace gravels (Pleistocene and upper Pliocene). The alluvium (Holocene) consists of unconsolidated gravel, sand, silt, and clay that was deposited by active stream channels and on adjoining floodplains. In the central Willamette Valley the unit may be as thick as 50 feet. Areas underlain by this unit may be subjected to significant flooding. The weathered terrace gravels (Pleistocene and upper Pliocene) are unconsolidated to semi-consolidated deposits of clay, silt, sand, and volcanic-clast gravel that have been preserved as incised terrace remnants. The terraces occur at multiple levels, at elevations of 5 to 100 feet above modern streams. The terrace gravels are up to about 140 feet thick.

2.2 Site Surface Conditions

The subject site is bounded by Jack Kelley Drive to the north, a forested property to the east, forest land and a railroad beyond to the south, and 8th Street to the west. At the time of our field investigation, the

site was undeveloped, relatively level to gently ascending to the south, and surfaced with short grasses, blackberry brambles, other brush, and scattered trees. A gravel-surfaced roadway provided vehicular access to the site from Jack Kelley Drive. The existing site conditions, topography, the proposed lift station, and other proposed features are shown on the attached Site Plan, Figure 2. Site conditions at the time of our field investigation are shown on Photographs 1 and 2, attached as Figure 3.

2.3 Subsurface Conditions

2.3.1 Subsurface Investigation & Laboratory Testing

Our subsurface investigation consisted of three drilled borings completed on November 2, 2017. The approximate exploration locations are shown on the Site Plan, attached as Figure 2. In summary, the borings were advanced to depths ranging from about 11½ to 41½ feet bgs. Details regarding the subsurface investigation, logs of the explorations, and results of laboratory testing are presented in Appendix A. Subsurface conditions encountered during our investigation are summarized below.

2.3.2 Subsurface Materials

Logs of the explorations are presented in Appendix A. The following describes each of the subsurface materials encountered at the site.

Fat Clay (CH)
Fat clay was encountered in each of the explorations and was generally medium stiff to stiff, dark brown, moist, and exhibited high plasticity. The fat clay extended to depths ranging between about 4 and 7 feet bgs.

Sandy Fat Clay (CH)
Sandy fat clay was encountered below the fat clay in borings B-1 and B-2 and was generally stiff to very stiff, light brown, moist, exhibited high plasticity, and fine-grained sand. The sandy fat clay extended to respective depths of about 7½ and 10 feet bgs in borings B-1 and B-2.

Silty Sand (SM)
Silty sand was encountered below the sandy fat clay in borings B-1 and B-2 and below the fat clay in boring B-3. The silty sand was generally loose to medium dense, and consisted of fine-grained sand. The silty sand extended to respective depths of about 15 and 11½ in borings B-1 and B-3, and to the maximum depth explored in boring B-2 (about 11½ feet bgs).

Poorly Graded Sand with Gravel & Silt (SP-SM)
Poorly graded sand with gravel and silt was encountered below the silty sand in borings B-1 and B-3 and was generally medium dense to dense, gray, wet, and consisted of medium to coarse-grained sand and sub-rounded to rounded gravel up to about ½ inch in diameter. Occasional gravel and cobbles, greater than 3 inches in diameter, were observed below about 15 feet bgs in boring B-3. The poorly graded sand with gravel and silt extended to about 25 feet bgs in boring B-1 and to the maximum depth explored in boring B-3 (about 16½ feet bgs).
Poorly Graded Gravel with Sand (GP)

Poorly graded gravel with sand was encountered below the poorly graded sand with gravel and silt in boring B-1 and extended to the maximum depth explored of about 41½ feet bgs. The poorly graded gravel with sand was generally very dense, gray to blue-gray, wet, and consisted of sub-angular to rounded gravel (and likely cobbles greater than 3 inches in diameter, based on drilling action) and coarse-grained sand.

2.3.3 Groundwater

We measured groundwater in borings B-1 and B-3 at respective depths of about 16 and 13½ feet bgs on November 2, 2017. Groundwater was not encountered within the depth explored in boring B-2 (about 11½ feet bgs). To determine approximate regional groundwater levels in the area, we researched available well logs located within Section 36, Township 17 South, Range 6 West on the Oregon Water Resources Department (OWRD)² website. Our review indicated that groundwater levels in the area varied with surface elevations and generally ranged from about 11 to 32 feet bgs, which are generally consistent with our findings during our field investigation. It should be noted that groundwater levels vary with local topography. In addition, the groundwater levels reported on the OWRD logs often reflect the purpose of the well, so water well logs may only report deeper, confined groundwater, while geotechnical or environmental borings will often report any groundwater encountered, including shallow, unconfined groundwater. Therefore, the levels reported on the OWRD well logs referenced above are considered generally indicative of local water levels and may not reflect actual groundwater levels at the project site. We anticipate that groundwater levels will fluctuate due to seasonal and annual variations in precipitation, changes in site utilization, or other factors. Additionally, the on-site fat clay (CH) soils are conducive to formation of perched groundwater.

3.0 SEISMIC DESIGN

Section 1613.3.2 of the 2014 Oregon Structural Specialty Code (2014 OSSC) requires that the determination of the seismic site class be based on subsurface data in accordance with Chapter 20 of the American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures (ASCE 7). Based on the results of the explorations and review of geologic mapping, we have assigned the site as Site Class D for the subsurface conditions encountered. Earthquake ground motion parameters for the site were obtained based on the United States Geological Survey (USGS) Seismic Design Values for Buildings - Ground Motion Parameter Web Application³. The site Latitude 44.052773° North and Longitude 123.358941° West were input as the site location. The following table shows the recommended seismic design parameters for the site.

---

Table 1: Seismic Ground Motion Values (Section 1613.5 of 2014 OSSC)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mapped Acceleration Parameters</td>
<td></td>
</tr>
<tr>
<td>Spectral Acceleration, 0.2 second ($S_s$)</td>
<td>0.917g</td>
</tr>
<tr>
<td>Spectral Acceleration, 1.0 second ($S_t$)</td>
<td>0.475g</td>
</tr>
<tr>
<td>Coefficients (Site Class D)</td>
<td></td>
</tr>
<tr>
<td>Site Coefficient, 0.2 sec. ($F_A$)</td>
<td>1.133</td>
</tr>
<tr>
<td>Site Coefficient, 1.0 sec. ($F_V$)</td>
<td>1.525</td>
</tr>
<tr>
<td>Adjusted MCE Spectral Response Parameters</td>
<td></td>
</tr>
<tr>
<td>MCE Spectral Acceleration, 0.2 sec. ($S_{MS}$)</td>
<td>1.039g</td>
</tr>
<tr>
<td>MCE Spectral Acceleration, 1.0 sec. ($S_{M1}$)</td>
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<tr>
<td>Design Spectral Response Accelerations</td>
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<tr>
<td>Design Spectral Acceleration, 1.0 second ($S_{D1}$)</td>
<td>0.483g</td>
</tr>
</tbody>
</table>

4.0 CONCLUSIONS

4.1 Overview

Based on the results of our field explorations and analyses, the site may be developed as described in Section 1.1 of this report, provided the recommendations presented in this report are incorporated into the design and development. We conclude the primary geotechnical considerations at this site include:

- The presence of high plasticity, fat clay (CH) that has a high expansion potential.
- Relatively shallow groundwater.
- The presence of near-surface, moisture-sensitive soils that are susceptible to disturbance during wet weather.

These considerations are described in more detail in the following sections.

4.2 Groundwater

As indicated in Section 2.3.3 above, we encountered groundwater between depths of about 13½ to 16 feet bgs during our field investigation. Consequently, dewatering should be planned for the proposed 25-foot deep wet well structure excavation and any associated deep utility trenches. Additionally, the submerged portion of the lift station vault walls should be designed to resist hydrostatic and uplift pressures.

4.3 Expansive Soils

As indicated in Section 2.3.2 above, we encountered fat clay (CH) from the ground surface to depths ranging from about 4 to 7 feet bgs. Based on Atterberg limits testing, the fat clay has a moderate to high expansion potential. This refers to the potential for changes in soil volume (shrinking or swelling) in response to changes in moisture content. Footings and floor slabs directly supported on expansive soils are susceptible to differential movements, possibly resulting in stress cracking, caused by the shrink/swell movements of this soil. Provisions to mitigate the effects of shrink/swell movements of the fat clay will need to be undertaken. Geotechnical recommendations for treatment of the fat clay are presented in Section 5.1.4.1 of this report.
4.4 Moisture-Sensitive Soils

Due to its fine-grained nature, the near surface fat clay (CH) soils are susceptible to disturbance during wet weather. Trafficability of these soils may be difficult, and significant damage to the subgrade could occur, if earthwork is undertaken without proper precautions at times when the exposed soils are more than a few percentage points above optimum moisture content. In the event that construction occurs during wet weather, CGT recommends measures be implemented to protect the fine-grained subgrade in areas of repeated construction traffic and in foundation bearing areas. Geotechnical recommendations for wet weather construction are presented in Section 5.3 of this report. Re-use of these soils as structural fill during wet times of the year will require special consideration as discussed in Section 5.4.1.1 of this report.

5.0 RECOMMENDATIONS

The recommendations presented in this report are based on the information provided to us, results of the field investigation, laboratory data, and professional judgment. CGT has observed only a small portion of the pertinent subsurface conditions. The recommendations are based on the assumptions that the subsurface conditions do not deviate appreciably from those found during the field investigation. CGT should be consulted for further recommendations if the design and/or location of the proposed development changes, or variations and/or undesirable geotechnical conditions are encountered during site development.

5.1 Site Preparation

5.1.1 Site Stripping

Existing vegetation and rooted surface soils at the site should be removed from within, and for a minimum 5-foot margin around, footprints of the planned lift station, associated buildings / structures and pavements. Based on the results of our field explorations, stripping depths at the site are anticipated to be less than 1 foot. However, these materials may be deeper or shallower at locations away from our explorations. The geotechnical engineer or his representative should provide recommendations for actual stripping depths based on observations during site stripping. Stripped surface vegetation and rooted soils should be transported off-site for disposal, or stockpiled for later use in landscaped areas. Stripped pavements and gravel fill can be stockpiled for later use as structural fill, provided the materials can be processed as recommended in Section 5.4.1 of this report.

5.1.2 Grubbing

Grubbing of trees and shrubs should include the removal of the root mass, and roots greater than ½-inch in diameter. Grubbed materials should be transported off-site for disposal. Where root masses are removed, the resulting excavation should be properly backfilled with imported granular structural fill in conformance with Section 5.4.2 of this report, as needed to achieve finished subgrade elevations.

5.1.3 Existing Utilities & Below-Grade Structures

All existing utilities at the site should be identified prior to excavation. Abandoned utility lines beneath the new building, pavements, and exterior hardscaping should be completely removed or grouted full.
Foundations, slabs-on-grade, and other buried structures (tanks, if any) encountered during site preparation should be completely removed and disposed of off-site and replaced with structural fill in conformance with Section 5.4 of this report.

5.1.4 Subgrade Preparation – Building Pad & Pavement Areas

5.1.4.1 Dry Weather Construction
After site preparation as recommended above, but prior to placement of structural fill or base course material, the geotechnical engineer or his representative should observe a proof roll test of the exposed subgrade soils in order to identify areas of excessive yielding. Proof rolling of subgrade soils is typically conducted during dry weather conditions using a fully-loaded, 10- to 12-cubic-yard, tire-mounted, dump truck or equivalent weighted water truck. Areas that appear too soft and wet to support proof rolling equipment should be prepared in general accordance with the recommendations for wet weather construction presented in Section 5.3 of this report. If areas of soft soil or excessive yielding are identified, the affected material should be over-excavated to firm, stable subgrade, and replaced with imported granular structural fill in conformance with Section 5.4.2 of this report.

As indicated above, the native fat clay (CH) encountered at the site has a moderate to high expansive potential. To mitigate the expansion potential, we recommend the following:

- Over-excavate and replaced with a minimum of 24 inches of imported granular structural fill within proposed shallow footing and floor slab locations.
- During excavation, the fat clay subgrade soils should be kept moist, near optimum moisture content, and not allowed to dry out. If allowed to dry below optimum moisture content, to a point where surface cracking appears in the subgrade, the affected material should be over-excavated and replaced with imported granular structural fill.

5.1.4.2 Wet Weather Construction
Preparation of subgrade soils within building and pavement areas during wet weather should be in conformance with Section 5.3 of this report. As indicated therein, increased base rock sections and a geotextile separation fabric may be required in wet conditions in order to support construction traffic and protect the subgrade. Cement amendment may also be considered to help stabilize subgrade soils during wet weather. If cement amendment is considered, the geotechnical engineer should be consulted to provide specific recommendations.

5.1.5 Erosion Control

Erosion and sedimentation control measures should be employed in accordance with applicable City, County, and State regulations regarding erosion control.

5.2 Temporary Excavations

5.2.1 Overview

All excavations should be in accordance with applicable OSHA and state regulations. It is the contractor's responsibility to select the excavation methods, to monitor site excavations for safety, and to design and provide any shoring required to protect personnel and adjacent improvements. A "competent person", as
defined by OR-OSHA, should be on-site during construction in accordance with regulations presented by OR-OSHA. CGT’s current role on the project does not include review or oversight of excavation safety.

5.2.2 OSHA Soil Type

For use in the planning and construction of temporary excavations up to 25 feet in depth, an OSHA soil type “B” may be used for the native fat clay (CH) and sandy fat clay (CH). An OSHA soil type “C” should be used for the native silty sand (SM), poorly graded sand with gravel with silt (SP-SM) and poorly graded gravel with sand (GP).

5.2.3 Dewatering

Based on the results of the explorations (i.e., groundwater encountered at approximately 15 feet bgs), we anticipate that the temporary excavation for the wet well construction extending to an approximate depth of 25 feet will require area-wide dewatering during construction. The subsurface conditions below the groundwater level consisted of predominately coarse-grained soils (i.e., sands and gravels), and we anticipate these soils will have relatively high transmissivity rates. Therefore, we anticipate pumping from deeper well points to maintain a stable excavation base will be required. Disposal locations should be reviewed by the project civil engineer.

In the event that it is impractical to maintain a stable excavation base, a “wet” method (i.e., caisson technique) of excavation may be necessary.

5.2.4 Utility Trenches

Temporary trench cuts should stand near vertical to depths of approximately 4 feet in the native fat clay (CH) and sandy fat clay (CH) encountered at the site. Some instability may occur in these soils if groundwater seepage is encountered. If seepage undermines the stability of the trench, or if caving of the sidewalls is observed during excavation, the sidewalls should be flattened or shored. Depending on the time of year trench excavations occur, trench dewatering may be required in order to maintain dry working conditions, particularly if the invert elevations of the proposed utilities are below the groundwater level. Pumping from sumps located within shallow trenches will likely be effective in removing water resulting from seepage. If groundwater is present at the base of utility excavations, we recommend placing trench stabilization material at the base of the excavations. Trench stabilization material should be in conformance with Section 5.4.4 of this report.

5.2.5 Excavations Near Foundations

Excavations near footings should not extend within a 1H:1V (horizontal:vertical) plane projected out and down from the outside, bottom edge of the footings. In the event that excavation needs to extend below the referenced plane, temporary shoring of the excavation and/or underpinning of the subject footing may be required. The geotechnical engineer should be consulted to review proposed excavation plans for this design case to provide specific recommendations.
5.2.6 Shoring Systems

5.2.6.1 Overview
Selection of the type and design of shoring systems used for this project will rest with the contractor. Based on the soil conditions encountered in boring B-1 (i.e., within the proposed wet well location), we anticipate that the wet well excavation can be facilitated using temporary soldier piles with timber or steel plate lagging. Since the wet well excavation will be about 25 feet deep, we anticipate that internal bracing may be required; from an economic standpoint (i.e., likely less expensive than a cantilevered wall) and to limit excessive lateral movement near the top of the excavation. Other feasible temporary excavation shoring methods to facilitate the installation of the wet well may include caisson construction, trench boxes, or the slide rail shoring system.

Based on the presence of gravels and cobbles and relatively dense conditions below a depth of about 15 feet bgs, sheet piles are not anticipated to be a practical temporary excavation shoring method, unless pre-drilling is performed prior to their installation.

5.2.6.2 Soil Parameters
Soil parameters typically required as part of design of temporary or permanent shoring systems are presented in the following table. The parameters presented therein were based on the results of the laboratory testing performed on selected samples, published correlations with SPT N-values, and experience with similar soils.

<table>
<thead>
<tr>
<th>Parameter1</th>
<th>Subsurface Material2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fat Clay (CH)</td>
</tr>
<tr>
<td>Depth Range (feet bgs)</td>
<td>0 to 4</td>
</tr>
<tr>
<td>Total Unit Weight, (\gamma^3) (pcf)</td>
<td>120</td>
</tr>
<tr>
<td>Friction Angle, (\Phi^3) (°)</td>
<td>24</td>
</tr>
<tr>
<td>Ultimate Coefficient of Active Pressure, (K_a^3)</td>
<td>0.37</td>
</tr>
<tr>
<td>Ultimate Coefficient of At Rest Pressure, (K_o^3)</td>
<td>0.59</td>
</tr>
<tr>
<td>Ultimate Coefficient of Passive Pressure, (K_p^3)</td>
<td>2.4</td>
</tr>
</tbody>
</table>

1 If additional soil parameters are required for design, the geotechnical engineer should be consulted.
2 Subsurface profile presented is based on subsurface conditions encountered in boring B-1 (see Figure A3 for boring log).
3 The groundwater level (phreatic surface) is assumed to be at 10 feet bgs at the site for temporary shoring design purposes.

5.3 Wet Weather Considerations
For planning purposes, the wet season should be considered to extend from late September to late June. It is our experience that dry weather working conditions should prevail between early July and the middle of September. Notwithstanding the above, soil conditions should be evaluated in the field by the
geotechnical engineer or his representative at the initial stage of site preparation to determine whether the recommendations within this section should be incorporated into construction.

5.3.1 General

The near-surface clayey soils (CH) are susceptible to disturbance during wet weather. Trafficability of these soils may be difficult, and significant damage to subgrade soils could occur, if earthwork is undertaken without proper precautions at times when the exposed soils are more than a few percentage points above optimum moisture content. For construction that occurs during wet weather, site preparation activities may need to be accomplished using track-mounted equipment, loading removed material onto trucks supported on granular haul roads, or other methods to limit soil disturbance. The geotechnical representative should evaluate the subgrade during excavation by probing rather than proof rolling. Soils that have been disturbed during site preparation activities, or soft or loose areas identified during probing, should be over-excavated to firm, stable subgrade, and replaced with imported granular structural fill.

5.3.2 Geotextile Separation Fabric

CGT recommends a geotextile separation fabric be placed to serve as a barrier between the prepared fine-grained subgrade and granular fill/base rock in areas of repeated or heavy construction traffic. The geotextile fabric should meet the requirements presented in the current Oregon Department of Transportation (ODOT) Standard Specification for Construction, Section 02320.

5.3.3 Granular Working Surfaces (Haul Roads & Staging Areas)

Haul roads subjected to repeated heavy, tire-mounted, construction traffic (e.g. dump trucks, concrete trucks, etc.) will require a minimum of 18 inches of imported granular material. For light staging areas, 12 inches of imported granular material is typically sufficient. Additional granular material, geo-grid reinforcement, or cement amendment may be recommended based on site conditions and/or loading at the time of construction. The imported granular material should be in conformance with Section 5.4.2 of this report and have less than 5 percent material passing the U.S. Standard No. 200 Sieve. The prepared subgrade should be covered with geotextile fabric prior to placement of the imported granular material. The imported granular material should be placed in a single lift (up to 24-inches deep) and compacted using a smooth-drum, non-vibratory roller until well-keyed.

5.4 Structural Fill

The geotechnical engineer should be provided the opportunity to review all materials considered for use as structural fill (prior to placement). The geotechnical engineer or his representative should be contacted to evaluate compaction of structural fill as the material is being placed. Evaluation of compaction may take the form of in-place density tests and/or proof roll tests with suitable equipment. Structural fill should be evaluated at intervals not exceeding every 2 vertical feet as the fill is being placed.
5.4.1 On-Site Soils – General Use

5.4.1.1 Native Fat Clay (CH), Sandy Fat Clay (CH), & Silty Sand (SM)

Re-use of the on-site, native fat clay (CH), sandy fat clay (CH), and native silty sand (SM) as structural fill may be difficult because these soils are sensitive to small changes in moisture content and are difficult, if not impossible, to adequately compact during wet weather. We anticipate the moisture content of these soils will be higher than the optimum moisture content for satisfactory compaction. Therefore, moisture conditioning (drying) should be expected in order to achieve adequate compaction. If used as structural fill, these soils should be free of organic matter, debris, and particles larger than 1½ inches. When used as structural fill, these soils should be placed in lifts with a maximum thickness of about 8 inches at moisture contents within –1 and +3 percent of optimum, and compacted to not less than 92 percent of the material’s maximum dry density, as determined in general accordance with ASTM D1557 (Modified Proctor).

5.4.1.2 Native Poorly Graded Sand w/ Gravel & Silt (SP-SM) and Poorly Graded Gravel w/ Sand (GP)

Re-use of the on-site, native sand and gravel soils (SP-SM & GP) as structural fill is feasible, provided these materials are kept clean of debris and particles larger than 4 inches in diameter. If reused as structural fill, the on-site sandy and gravel soils should be prepared in accordance with Section 5.4.2 of this report.

If the on-site soils cannot be properly moisture-conditioned and/or processed, we recommend using imported granular material for structural fill.

5.4.2 Imported Granular Structural Fill – General Use

Imported granular structural fill should consist of angular pit or quarry run rock, crushed rock, or crushed gravel that is fairly well graded between coarse and fine particle sizes. The granular fill should contain no organic matter, debris, or particles larger than 4 inches, and have less than 5 percent material passing the U.S. Standard No. 200 Sieve. For fine-grading purposes, the maximum particle size should be limited to 1½ inches. The percentage of fines can be increased to 12 percent of the material passing the U.S. Standard No. 200 Sieve if placed during dry weather, and provided the fill material is moisture-conditioned, as necessary, for proper compaction. Granular fill material should be placed in lifts with a maximum thickness of about 12 inches, and compacted to not less than 95 percent of the material’s maximum dry density, as determined in general accordance with ASTM D1557 (Modified Proctor). Proper moisture conditioning and the use of vibratory equipment will facilitate compaction of these materials.

Compaction of granular fill materials with high percentages of particle sizes in excess of 1½-inches should be evaluated by periodic proof-roll observation or continuous observation by the CGT geotechnical representative during fill placement, since it cannot be tested conventionally using a nuclear densometer. Such materials should be “capped” with a minimum of 12 inches of 1½-inch minus (or finer) granular fill under all structural elements (footings, concrete slabs, etc.).
5.4.3 Floor Slab Base Rock

Floor slab base rock should consist of well-graded granular material (crushed rock) containing no organic matter or debris, have a maximum particle size of ¾ inch, and have less than 5 percent material passing the U.S. Standard No. 200 Sieve. Floor slab base rock should be placed in one lift and compacted to not less than 95 percent of the material’s maximum dry density as determined in general accordance with ASTM D1557 (Modified Proctor).

5.4.4 Trench Base Stabilization Material

If groundwater is present at the base of utility excavations, trench base stabilization material should be placed. Trench base stabilization material should consist of a minimum of 1 foot of well-graded granular material with a maximum particle size of 4 inches and less than 5 percent material passing the U.S. Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material, placed in one lift, and compacted until well-keyed.

5.4.5 Trench Backfill Material

Trench backfill for the utility pipe base and pipe zone should consist of granular material as recommended by the utility pipe manufacturer. Trench backfill above the pipe zone should consist of well-graded granular material containing no organic matter or debris, have a maximum particle size of ¾ inch, and have less than 8 percent material passing the U.S. Standard No. 200 Sieve. As a guideline, trench backfill should be placed in maximum 12-inch thick lifts. The earthwork contractor may elect to use alternative lift thicknesses based on their experience with specific equipment and fill material conditions during construction in order to achieve the required compaction. The following table presents recommended relative compaction percentages for utility trench backfill.

<table>
<thead>
<tr>
<th>Table 3: Utility Trench Backfill Compaction Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Backfill Zone</strong></td>
</tr>
<tr>
<td>Pipe Base and Within Pipe Zone</td>
</tr>
<tr>
<td>Above Pipe Zone</td>
</tr>
<tr>
<td>Within 3 Feet of Design Subgrade</td>
</tr>
</tbody>
</table>

1 Includes proposed building, pavements, hardscaping, etc.

5.5 Wet Well Design Considerations

5.5.1 General

As indicated in Section 1.1 above, we understand the wet well will be an 8-foot diameter (inner), approximate 25-foot deep (below existing site grades), precast concrete structure. Design of the wet well structure, as well as selection of the method for installation, will rest with others. The wet well for the lift station will need to resist lateral earth pressures and buoyancy forces on the embedded structure.
5.5.2 Design Lateral & Uplift Pressures

The embedded walls of the wet well should be designed for at-rest (i.e., non-yielding) earth pressure conditions. Depending on the installation method, we anticipate backfill materials will consist of granular structural fill in conformance with Section 5.4 of this report.

We recommend the following for design lateral and uplift pressures:

- An at-rest, equivalent fluid density of 50 pcf (triangular distribution) acting on the embedded walls of the wet well.
- For the portion of the embedded walls of the wet well below the groundwater level, an additional 40 pcf equivalent fluid density (triangular distribution) should be included to calculate hydrostatic pressures acting on the structure (i.e., total equivalent fluid density of 90 pcf). This value is based on a recommended design groundwater level of 10 feet bgs; to account for seasonal and/or annual fluctuation, as well as potential rises in static groundwater level.
- We recommend including a lateral pressure of 100 psf (rectangular distribution) to account for maintenance equipment / vehicular surcharge loading at the surface of the wet well
- For seismic conditions, an additional 5 pcf equivalent fluid density (rectangular distribution) should be included over the entire depth of the wet well. The seismic resultant force should be applied at 0.6H, from the bottom of the wet well.
- Buoyancy forces should be evaluated (and mitigated, if required) in general accordance with Section 3.2.2 of ASCE 7-10. The following equation is presented for calculation of the buoyancy force, \( F_b \), on the underside of floor slabs:

\[
F_b = \gamma_w \cdot A \cdot H
\]

where:
- \( F_b \) = Buoyancy force, in pounds
- \( \gamma_w \) = Unit weight of water, 62.4 pcf
- \( A \) = Area of underside of floor slab, in square feet
- \( H \) = Height of water that is displaced (submerged depth), in feet

5.5.3 Foundation Support

Assuming the excavation for the wet well will extend to an approximate depth of 25 feet bgs, we anticipate the base of the wet well being supported on very dense, poorly graded gravel with sand. To provide a firm and level bearing surface, we recommend placing a minimum 4-inch thick leveling course, consisting of well-compacted granular structural fill in general accordance with Section 5.4.2. For design purposes, an allowable bearing pressure of 5,000 psf may be used. This bearing pressure is a net bearing pressure, applies to the total of dead and long-term live loads, and may be increased by one-third when considering seismic or wind loads. For foundations founded as recommended above, total settlement of foundations (from static loading) is anticipated to be less than \( \frac{1}{2} \) inch. Similarly, for static loading conditions, differential settlements across the wet well foundation should not exceed \( \frac{1}{4} \) inch. The geotechnical engineer or his representative should verify wet well subgrade conditions prior to placing forms or reinforcing steel.

If the wet well foundation is designed as a mat foundation, we recommend a modulus of subgrade reaction of 300 pounds per cubic inch (pci).
5.5.4 Uplift Resistance

Common methods to resist uplift forces are increasing the perimeter wall thickness and/or base slab thickness of the wet well structure, and extending the base slab of the wet well beyond the perimeter walls. If the latter method is used, we recommend that only the weight of the backfill material within the annulus extending vertically from the outer edge of the base slab be used for additional uplift resistance. Although side resistance or “skin friction” forces will provide additional uplift resistance, we recommend these be neglected for design purposes.

In the event the buoyancy force is in excess of the structural weight of the slab(s), slab anchoring will be required to prevent floatation post-construction (i.e. after dewatering wells are taken offline). Ground anchors may be considered to help provide additional uplift capacity. The geotechnical engineer should be consulted to provide additional recommendations for ground anchors, if warranted.

5.6 Shallow Spread Foundations (Building)

5.6.1 Subgrade Preparation

Satisfactory subgrade support for shallow foundations associated with the proposed maintenance building and other ground-level structures can be obtained by over-excavating and replacing a minimum of 24 inches of imported granular structural fill placed and compacted on the native, medium stiff to better, fat clay (CH).

During excavation, the fat clay subgrade soils should be kept moist, near optimum moisture content, and not allowed to dry out. If allowed to dry below optimum moisture content, to a point where surface cracking appears in the subgrade, the affected material should be over-excavated and replaced with imported granular structural fill.

The geotechnical engineer or his representative should be contacted to observe subgrade conditions prior to placement of the granular pad. If soft, loose, or otherwise unsuitable soils are encountered, they should be over-excavated as recommended by the geotechnical representative at the time of construction. The resulting over-excavation should be brought back to grade with imported granular structural fill in conformance with Section 5.4.2 of this report. All granular pads for footings should be constructed a minimum of 6 inches wider on each side of the footing for every vertical foot of over-excavation.

5.6.2 Minimum Footing Width & Embedment

Minimum footing widths should be in conformance with the most recent, Oregon Structural Specialty Code (OSSC). As a guideline, we recommend individual spread footings have a minimum width of 24 inches. Similarly, for one-story, light-framed structures, we recommend continuous wall footings have a minimum width of 12 inches. For two-story, light-framed structures, we recommend continuous wall footings have a minimum width of 15 inches. For three- to four-story, light-framed structures, we recommend continuous wall footings have a minimum width of 18 inches. All footings should be founded at least 18 inches below the lowest, permanent adjacent grade.
5.6.3 Bearing Pressure & Settlement

Footings founded as recommended above should be proportioned for a maximum allowable soil bearing pressure of 2,500 pounds per square foot (psf). This bearing pressure is a net bearing pressure, applies to the total of dead and long-term live loads, and may be increased by one-third when considering seismic or wind loads. For foundations founded as recommended above, total settlement of foundations (from static loading) is anticipated to be less than 1 inch. Similarly, for static loading conditions, differential settlements between adjacent columns and/or bearing walls should not exceed ½ inch.

5.6.4 Lateral Capacity

A maximum passive (equivalent fluid) earth pressure of 150 pounds per cubic foot (pcf) is recommended for design of footings confined by the native soils described above, or imported granular structural fill that is properly placed and compacted during construction. The recommended earth pressure was computed using a factor of safety of 1½, which is appropriate due to the amount of movement required to develop full passive resistance. In order to develop the above capacity, the following should be understood:

1. Concrete must be poured neat in excavations or the foundations must be backfilled with imported granular structural fill,
2. The adjacent grade must be level,
3. The static ground water level must remain below the base of the footings throughout the year.
4. Adjacent floor slabs, pavements, or the upper 12-inch-depth of adjacent, unpaved areas should not be considered when calculating passive resistance.

An ultimate coefficient of friction equal to 0.45 may be used when calculating resistance to sliding for footings founded on the recommended minimum 24 inches of imported granular structural fill (crushed rock) that is properly placed and compacted during construction.

5.6.5 Subsurface Drainage

Recognizing the fine-grained nature of the native soils, placement of building perimeter foundation drains is recommended at the base elevations of continuous wall footings on the outside of footings. Foundation drains should consist of a minimum 4-inch diameter, perforated, HDPE (High Density Polyethylene) drainpipe wrapped with a non-woven geotextile filter fabric. The drains should be backfilled with a minimum of 2 cubic feet of open graded drain rock per lineal foot of pipe. The drain rock should be encased in a geotextile filter fabric in order to provide separation from the surrounding soils. Foundation drains should be positively sloped and should outlet to a suitable discharge point. A representative from CGT should be contacted to observe the drains prior to backfilling. Roof drains should not be tied into foundation drains.
5.7 Floor Slabs

5.7.1 Subgrade Preparation

Satisfactory subgrade support for floor slabs constructed on grade, supporting up to 200 psf area loading, can be obtained by over-excavating and replacing with a minimum of 24 inches of imported granular structural fill placed and compacted on the native, medium stiff to better, fat clay (CH).

During excavation, the fat clay subgrade soils should be kept moist, near optimum moisture content, and not allowed to dry out. If allowed to dry below optimum moisture content, to a point where surface cracking appears in the subgrade, the affected material should be over-excavated and replaced with imported granular structural fill.

The geotechnical engineer or his representative should be contacted to observe subgrade conditions prior to placement of the granular pad. If soft, loose, or otherwise unsuitable soils are encountered, they should be over-excavated as recommended by the geotechnical representative at the time of construction. The resulting over-excavation should be brought back to grade with imported granular structural fill in conformance with Section 5.4.2 of this report. All granular pads for footings should be constructed a minimum of 6 inches wider on each side of the footing for every vertical foot of over-excavation.

5.7.2 Crushed Rock Base

Concrete floor slabs should be supported on a minimum 4-inch thick layer of crushed rock (base rock). The crushed rock base should conform to the recommendations presented in Section 5.4.3 of this report. For design cases where a vapor barrier or retarder is not placed below the slab, the surface of the base rock should be choked with sand just prior to concrete placement. Choking means the voids between the largest aggregate particles are filled with sand, but does not provide a layer of sand above the base rock. Choking the base rock surface reduces the lateral restraint on the bottom of the concrete during curing.

5.7.3 Design Considerations

For floor slabs constructed as recommended, a modulus of subgrade reaction of 150 pounds per cubic inch (pci) is recommended for the design of the floor slab. Floor slabs constructed as recommended will likely settle less than ½ inch. For general floor slab construction, slabs should be jointed around columns and walls to permit slabs and foundations to settle differentially.

5.7.4 Subgrade Moisture Considerations

Liquid moisture and moisture vapor should be expected at the subgrade surface. The recommended crushed rock base is anticipated to provide protection against liquid moisture. Where moisture vapor emission through the slab must be minimized, e.g. impervious floor coverings, storage of moisture sensitive materials directly on the slab surface, etc., a vapor retarding membrane or vapor barrier below the slab should be considered. Factors such as cost, special considerations for construction, floor coverings, and end use suggest that the decision regarding a vapor retarding membrane or vapor barrier be made by the architect and owner.
If a vapor retarder or vapor barrier is placed below the slab, its location should be based on current American Concrete Institute (ACI) guidelines, ACI 302 Guide for Concrete Floor and Slab Construction. In some cases, this indicates placement of concrete directly on the vapor retarder or barrier. Please note that the placement of concrete directly on impervious membranes increases the risk of plastic shrinkage cracking and slab curling in the concrete. Construction practices to reduce or eliminate such risk, as described in ACI 302, should be employed during concrete placement.

5.8 Additional Drainage Considerations

Subsurface drains should be connected to the nearest storm drain or other suitable discharge point. Paved surfaces and grading near or adjacent to the building should be sloped to drain away from the building. Surface water from paved surfaces and open spaces should be collected and routed to a suitable discharge point. Surface water should not be directed into foundation drains.

6.0 RECOMMENDED ADDITIONAL SERVICES

6.1 Design Review

Geotechnical design review is of paramount importance. CGT recommends that the geotechnical design review take place prior to releasing bid packets to contractors.

6.2 Observation of Construction

Satisfactory earthwork, foundation, and pavement performance depends to a large degree on the quality of construction. Sufficient observation of the contractor’s activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during subsurface explorations, and recognition of changed conditions often requires experience. We recommend that qualified personnel visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those observed to date and anticipated in this report.

We recommend that the geotechnical engineer or their representative attend a pre-construction meeting coordinated by the contractor and/or developer. The project geotechnical engineer or their representative should provide observations and/or testing of at least the following earthwork elements during construction:

- Stripping, Grubbing and Demolition.
- Subgrade Preparation for Wet Well, Structural Fills, Shallow Foundations, Floor Slabs, and Pavements.
- Compaction of Structural Fill.
- Compaction of Utility Trench Backfill.
- Placement of Foundation Drains and Other Drains.
- Compaction of Base Rock for Floor Slabs and Pavements.
It is imperative that the owner and/or contractor request earthwork observations and testing at a frequency sufficient to allow the geotechnical engineer to provide a final letter of compliance for the earthwork activities.

7.0 LIMITATIONS

We have prepared this report for use by the owner/developer and other members of the design and construction team for the proposed development. The opinions and recommendations contained within this report are not intended to be, nor should they be construed as a warranty of subsurface conditions, but are forwarded to assist in the planning and design process.

We have made observations based on our explorations that indicate the soil conditions at only those specific locations and only to the depths penetrated. These observations do not necessarily reflect soil types, strata thickness, or water level variations that may exist between or away from our explorations. If subsurface conditions vary from those encountered in our site explorations, CGT should be alerted to the change in conditions so that we may provide additional geotechnical recommendations, if necessary. Observation by experienced geotechnical personnel should be considered an integral part of the construction process.

The owner/developer is responsible for ensuring that the project designers and contractors implement our recommendations. When the design has been finalized, prior to releasing bid packets to contractors, we recommend that the design drawings and specifications be reviewed by our firm to see that our recommendations have been interpreted and implemented as intended. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification. Design review and construction phase testing and observation services are beyond the scope of our current assignment, but will be provided for an additional fee.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor’s methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Geotechnical engineering and the geologic sciences are characterized by a degree of uncertainty. Professional judgments presented in this report are based on our understanding of the proposed construction, familiarity with similar projects in the area, and on general experience. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared; no warranty, expressed or implied, is made. This report is subject to review and should not be relied upon after a period of three years.
JACK KELLEY DRIVE LIFT STATION - VENETA, OREGON
Project Number G1704699

FIGURE 1
Site Location

Map created ESRI ArcGIS Pro and ESRI Topographic Basemap.
Township 17 South, Range 06 West, Section 36 Willamette Meridian

Latitude: 44.052773° North
Longitude: 123.358941° West

1 Inch = 2,000 feet
NOTES: Drawing based on observations made while on site and site plans provided by client. All exploration locations should be considered approximate.
See Figure 2 for approximate photograph locations and directions. Photographs were taken at the time of our fieldwork.
Appendix A: Subsurface Investigation and Laboratory Testing

Jack Kelley Drive Lift Station
Jack Kelley Drive & 8th Street
Veneta, Oregon

CGT Project Number G1704699

January 11, 2018

Prepared For:

Civil West Engineering Services, Inc.
c/o: Ms. Manda Catterlin
945 Geary Street
Albany, Oregon 97321

Prepared by
Carlson Geotechnical

Exploration Key..................................................................................................................................... Figure A1
Soil Classification.................................................................................................................................. Figure A2
Exploration Logs .................................................................................................................................Figures A3 – A5
Appendix A: Subsurface Investigation
Jack Kelley Drive Lift Station
Veneta, Oregon
CGT Project Number G1704699
January 11, 2018

A.1.0 SUBSURFACE INVESTIGATION

Our field investigation consisted of three borings completed on November 2, 2017. The approximate exploration locations are shown on the Site Plan, attached to the geotechnical report as Figure 2. The exploration locations shown therein were determined based on measurements from existing site features (edges of pavement, fire hydrant, etc.) and should be considered approximate. Surface elevations indicated on the logs were estimated based on the topographic contours as shown on the Site Plan attached to the geotechnical report (Figure 2) and should be considered approximate.

A.1.1 Drilled Borings

The borings (B-1 through B-3) were advanced at the site to depths ranging from about 11½ to 41½ feet bgs using a CME-55 track-mounted drill rig provided and operated by our subcontractor, Western States Soil Conservation of Hubbard, Oregon. The borings were advanced using the hollow-stem auger drilling technique. Upon completion, the borings were backfilled with granular bentonite. Drilling waste (cuttings) were left onsite.

Standard Penetration Tests (SPTs) were conducted within the borings using a standard split-spoon sampler and a Modified California (MC) sampler in general accordance with American Society for Testing and Materials (ASTM) D1586 and ASTM G3550, respectively. The SPTs and MCs were conducted at 2½- to 5-foot intervals to the termination depths of the borings. The SPT and MC are described on the attached Exploration Key, Figure A1.

A.1.2 Material Classification & Sampling

Soil samples were obtained at selected intervals in the borings using the referenced split-spoon samplers and a thin-walled, steel (Shelby) tube sampler, detailed on Figure A1. A member of CGT’s geological staff collected the samples and logged the soils in general accordance with the Visual-Manual Procedure (ASTM 2488). An explanation of this classification system is attached as Figure A2. The SPT and MC samples were stored in sealable plastic bags and the Shelby tube sample was sealed with caps and tape and transported to our soils laboratory for further examination and testing. Our geotechnical staff visually examined all samples in order to refine the initial field classifications.

A.1.3 Subsurface Conditions

Subsurface conditions are summarized in Section 2.3.2 of the geotechnical report. Detailed logs of the explorations are presented on the attached exploration logs, Figures A3 through A5.

A.1.4 Laboratory Testing

Laboratory testing was performed on samples collected in the field to refine our initial field classifications and determine in-situ parameters. Laboratory testing included the following:

- Twelve moisture content determinations (ASTM D2216).
- One Atterberg limits (plasticity) test (ASTM D4318).
- Three percentage passing the U.S. Standard No. 200 Sieve tests (ASTM D1140).

Results of the laboratory tests are shown on the exploration logs.
### GEOTECHNICAL LABORATORY TESTING

<table>
<thead>
<tr>
<th>PL</th>
<th>MC</th>
<th>LL</th>
</tr>
</thead>
</table>

Atterberg limits (plasticity) test results (ASTM D4318): PL = Plastic Limit, LL = Liquid Limit, and MC = Moisture Content (ASTM D2216)

- **FINES CONTENT (%)** Percentage passing the U.S. Standard No. 200 Sieve (ASTM D1140)

<table>
<thead>
<tr>
<th>GRAB</th>
</tr>
</thead>
</table>

- **Grab sample**

### SAMPLING

- **SPT**
  - *Standard Penetration Test* (SPT) consists of driving a 2-inch, outside-diameter, split-spoon sampler into the undisturbed formation with repeated blows of a 140-pound hammer falling a vertical distance of 30 inches (ASTM D1586). The number of blows (N-value) required to drive the sampler the last 12 inches of an 18-inch sample interval is used to characterize the soil consistency or relative density. The drill rig was equipped with an cat-head or automatic hammer to conduct the SPTs. The observed N-values, hammer efficiency, and N<sub>60</sub> are noted on the boring logs.

- **MC**
  - *Modified California* sampling consists of 3-inch, outside-diameter, split-spoon sampler (ASTM G3550) driven similarly to the SPT sampling method described above. A sampler diameter correction factor of 0.44 is applied to calculate the equivalent SPT N<sub>60</sub> value per Lacroix and Horn, 1973.

- **CORE**
  - *Rock Coring* interval

- **SH**
  - *Shelby Tube* is a 3-inch, inner-diameter, thin-walled, steel tube push sampler (ASTM D1587) used to collect relatively undisturbed samples of fine-grained soils.

- **WDCP**
  - *Wildcat Dynamic Cone Penetrometer* (WDCP) test consists of driving 1.1-inch diameter, steel rods with a 1.4-inch diameter, cone tip into the ground using a 35-pound drop hammer with a 15-inch free-fall height. The number of blows required to drive the steel rods is recorded for each 10 centimeters (3.94 inches) of penetration. The blow count for each interval is then converted to the corresponding SPT N<sub>60</sub> values.

- **DCP**
  - *Dynamic Cone Penetrometer* (DCP) test consists of driving a 20-millimeter diameter, hardened steel cone on 16-millimeter diameter steel rods into the ground using a 10-kilogram drop hammer with a 460-millimeter free-fall height. The depth of penetration in millimeters is recorded for each drop of the hammer.

- **POCKET PEN. (tsf)**
  - *Pocket Penetrometer* test is a hand-held instrument that provides an approximation of the unconfined compressive strength in tons per square foot (tsf) of cohesive, fine-grained soils.

### CONTACTS

- **Observed (measured)** contact between soil or rock units.
- **Inferred (approximate)** contact between soil or rock units.
- **Transitional (gradational)** contact between soil or rock units.

### ADDITIONAL NOTATIONS

- **Italics** Notes drilling action or digging effort
- **{ Braces }** Interpretation of material origin/geologic formation (e.g. { Base Rock } or { Columbia River Basalt })
### Classification of Terms and Content

<table>
<thead>
<tr>
<th>USCS Grain Size</th>
<th>Classification of Terms and Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fines</td>
<td>#&lt;#200 (0.075 mm)</td>
</tr>
<tr>
<td>Sand</td>
<td>Fine</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Coarse</td>
</tr>
<tr>
<td>Gravel</td>
<td>Fine</td>
</tr>
<tr>
<td></td>
<td>Coarse</td>
</tr>
<tr>
<td>Cobbles</td>
<td>3 to 12 inches; scattered &lt;15% estimated</td>
</tr>
<tr>
<td></td>
<td>numerous &gt;15% estimated</td>
</tr>
<tr>
<td>Boulders</td>
<td>&gt; 12 inches</td>
</tr>
</tbody>
</table>

#### Other Constituents
- Grain Shape, Approximate Gradation
- Organics, Cement, Structure, Odor, etc.
- Geologic Name or Formation

### Relative Density or Consistency

<table>
<thead>
<tr>
<th>Granular Material</th>
<th>Fine-Grained (cohesive) Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPT N-Value</td>
<td>Density</td>
</tr>
<tr>
<td>Torvane tsf</td>
<td>Pocket Pen tsf</td>
</tr>
<tr>
<td>Shear Strength</td>
<td>Unconfined</td>
</tr>
<tr>
<td>Consistency</td>
<td>Manual Penetration Test</td>
</tr>
<tr>
<td>Very Loose</td>
<td>&lt;2</td>
</tr>
<tr>
<td>2 - 4</td>
<td>0.13 - 0.25</td>
</tr>
<tr>
<td>4 - 8</td>
<td>0.25 - 0.50</td>
</tr>
<tr>
<td>8 - 15</td>
<td>1.00 - 2.00</td>
</tr>
<tr>
<td>15 - 30</td>
<td>2.00 - 4.00</td>
</tr>
<tr>
<td>&gt;30</td>
<td>&gt;4.00</td>
</tr>
</tbody>
</table>

#### Moisture Content
- Dry: Absence of moisture, dusty, dry to the touch
- Damp: Some moisture but leaves no moisture on hand
- Moist: Leaves moisture on hand
- Wet: Visible free water, likely from below water table

#### Plasticity

| ML    | Non to Low       | Non to Low       | Slow to Rapid | Low, can't roll |
| CL    | Low to Medium    | Medium to High   | None to Slow  | Medium          |
| MH    | Medium to High   | Low to Medium    | None to Slow  | Low to Medium   |
| CH    | Medium to High   | High to Very High| None          | High            |

#### Dilatancy

| GW    | Clean Gravels    | Well-graded gravels and gravel/sand mixtures, little or no fines |
| GP    | Gravels with Fines | Poorly-graded gravels and gravel/sand mixtures, little or no fines |
| GM    | Silty gravels, gravel/sand/silt mixtures |
| GC    | Clayey gravels, gravel/sand/clay mixtures |
| SW    | Well-graded sands and gravelly sands, little or no fines |
| SP    | Poorly-graded sands and gravelly sands, little or no fines |
| SM    | Silty sands, sand/silt mixtures |
| SC    | Clayey sands, sand/clay mixtures |

#### Toughness

| ML    | Inorganic silts, rock flour, clayey silts |
| CL    | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays |
| OL    | Organic silt and organic silty clays of low plasticity |
| MH    | Inorganic silts, clayey silts |
| CH    | Inorganic clays of high plasticity, fat clays |
| OH    | Organic clays of medium to high plasticity |

### Visual-Manual Classification

#### Major Divisions

<table>
<thead>
<tr>
<th>Gravel Divisions</th>
<th>Group Symbols</th>
<th>Typical Names</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Grained Soils: More than 50% retained on No. 4 sieve</td>
<td>GW</td>
<td>Well-graded gravels and gravel/sand mixtures, little or no fines</td>
</tr>
<tr>
<td></td>
<td>GP</td>
<td>Poorly-graded gravels and gravel/sand mixtures, little or no fines</td>
</tr>
<tr>
<td></td>
<td>GM</td>
<td>Silty gravels, gravel/sand/silt mixtures</td>
</tr>
<tr>
<td></td>
<td>GC</td>
<td>Clayey gravels, gravel/sand/clay mixtures</td>
</tr>
<tr>
<td></td>
<td>SW</td>
<td>Well-graded sands and gravelly sands, little or no fines</td>
</tr>
<tr>
<td></td>
<td>SP</td>
<td>Poorly-graded sands and gravelly sands, little or no fines</td>
</tr>
<tr>
<td></td>
<td>SM</td>
<td>Silty sands, sand/silt mixtures</td>
</tr>
<tr>
<td></td>
<td>SC</td>
<td>Clayey sands, sand/clay mixtures</td>
</tr>
<tr>
<td>Fine-Grained Soils: 50% or more passes No. 200 sieve</td>
<td>ML</td>
<td>Inorganic silts, rock flour, clayey silts</td>
</tr>
<tr>
<td></td>
<td>CL</td>
<td>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays</td>
</tr>
<tr>
<td></td>
<td>OL</td>
<td>Organic silt and organic silty clays of low plasticity</td>
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</tr>
<tr>
<td></td>
<td>CH</td>
<td>Inorganic clays of high plasticity, fat clays</td>
</tr>
<tr>
<td></td>
<td>OH</td>
<td>Organic clays of medium to high plasticity</td>
</tr>
<tr>
<td>Highly Organic Soils</td>
<td>PT</td>
<td>Peat, muck, and other highly organic soils</td>
</tr>
</tbody>
</table>

- Boring terminated at 41½ feet bgs.
- Groundwater encountered at 15 feet bgs during drilling, and measured at 16 feet bgs after drilling.
- Boring backfilled with cuttings and bentonite chips upon completion.

FAT CLAY: Medium stiff, dark brown, moist, medium to high plasticity, frequent rootlets in upper 12 inches.
Light brown, orange and tan mottling, and no roots below about 2½ feet bgs.

SANDY FAT CLAY: Very stiff, light brown, moist, low plasticity, fine sand, orange and tan mottling.

SILTY SAND: Medium dense, light brown, moist, fine- to medium-grained sand.
Finer sand below about 10 feet bgs.
Medium- to coarse-grained sand below about 12½ feet bgs.

POORLY GRADED SAND WITH GRAVEL AND SILT: Medium dense, gray, wet, consisting of medium- to coarse-grained sand and pea-sized rounded and subrounded gravels.
Water table encountered at 15 feet bgs during drilling.
Dense below about 20 feet bgs.

POORLY GRADED GRAVEL WITH SAND: Very dense, gray to blue-gray, wet, consisting of medium- to coarse-grained sand and subangular to subrounded gravels up to about ½ inch in diameter, occasional larger diameter gravels and potentially cobbles based on drilling action.
**FAT CLAY:** Medium stiff, dark brown, moist, high plasticity, frequent rootlets in upper 12 inches.

Shelby tube pushed at 2½ feet bgs.
450 psi first foot per driller
550 psi second foot per driller

Light brown with orange and tan mottling, trace fine-grained sand below about 5 feet bgs.

**SANDY FAT CLAY:** Stiff, brown, moist, medium to high plasticity, fine-grained sand.

**SILTY SAND:** Loose, light brown, moist, fine-grained sand.

- Boring terminated at 11½ feet bgs.
- No groundwater or caving within depth explored.
- Boring backfilled with cuttings and bentonite chips upon completion.
FAT CLAY: Stiff, dark brown, moist, medium to high plasticity.

Light brown and fine sand inclusions below about 2 feet bgs.

SILTY SAND: Loose to medium dense, light brown, moist, rootlets and trace roots up to ¼ inch diameter.

Some pea-sized rounded to subrounded gravels at 11½ feet bgs.

POORLY GRADED SAND WITH GRAVEL: Medium dense, fine- to medium-coarse grained sand, subrounded gravel up to ½ inch diameter.

Occasional gravel up to 3 inches in diameter and cobbles greater than 3 inches in diameter observed below about 15 feet bgs.

Boring terminated at 16½ feet bgs.

Water table encountered at 11½ feet bgs during drilling, water table at 13½ feet bgs 10 minutes after completing boring.

Boring backfilled with cuttings and bentonite chips upon completion.